



The State of Missouri's Natural Resources 2014



Director's Message



Missouri is blessed with natural resource diversity and abundance like no other state in the nation. Its varied landscapes extend from the rolling farmlands in the north to the Ozark hills in the south to the Mississippi River bottoms in the east to the open prairies in the west. Our water resources are equally as diverse from the crystal clear spring-fed streams to the man-made recreational lakes to the major navigational waters of the Mississippi and Missouri rivers. And the quality of our air sustains us in everything we do while spending time outdoors and exploring nature – whether it's working in the yard, floating down an Ozark stream or cycling through a Missouri State Park.

Today's fast-paced world is filled with emerging technology, demanding schedules, increasing responsibilities and never-ending opportunities making it difficult to pause and find a few moments of peace and stillness. This valuable time allows us the opportunity to reflect on the things that are most important to us ... our families, our friends, our health and our quality of life.

The health and quality of life for the more than 6 million people living in Missouri can be closely tied to the health and quality of our state's air, land and water resources. We depend on good quality water for drinking. We depend on an abundance of water and healthy land for agriculture and industrial purposes. We want to be surrounded by clean, pristine rivers and lakes when we are swimming, canoeing, boating and wading in our waters. And clean air is essential to our health. Our very existence depends on enriching Missouri's natural resources as well as the environmental and economic vitality of our state.

This year, the Department of Natural Resources is celebrating 40 years of taking care of Missouri's natural resources. The

department's role in protecting these resources is established in law as a reflection of the public will – that government should protect our air, land, water resources as well as our state parks and historic sites in public trust for all Missourians. Our role is critically important.

We invite you to explore the department's 2014 State of Missouri's Natural Resources report and learn more about the accomplishments and improvements we have made to date. This report provides a comprehensive look at our resources, where we've been, where we are going and what challenges we expect to face in the future.

The Missouri we enjoy today is certainly more picturesque and pristine than it was 40 years ago. We've come a long way and though the impact of pollution may not be as visibly evident, we know there is still work to do. The environmental challenges we faced in the past, improved science and technology, and the lessons learned along the journey have and will continue to influence the decisions we make.

Ensuring future generations have quality air, land, water and parks is something that will take the effort of more than just government – there's a role for all of us. With your help, the Department of Natural Resources will continue to ensure a healthy environment in which to live, work and enjoy the great outdoors.

Enhancing Missouri – it's in our nature.

Sara Parker Pauley,
Director

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The mission of the Missouri Department of Natural Resources is to protect Missouri's air, land and water; to preserve unique natural and historic places, and to provide recreational and learning opportunities for everyone.

Nothing in this document may be used to implement any enforcement action or levy any penalty unless promulgated by rule under chapter 536 or authorized by statute.

All photos by DNR staff unless otherwise indicated. Back cover: Mark Twain Lake, Monroe County.



Department Strategic Priorities

The Department of Natural Resources has established a number of strategic priorities and foundational activities that will more fully achieve the department's mission and strategic vision. The department is completing its strategic vision by updating its strategic plan, key priorities and activities that will provide the framework for an even stronger future.

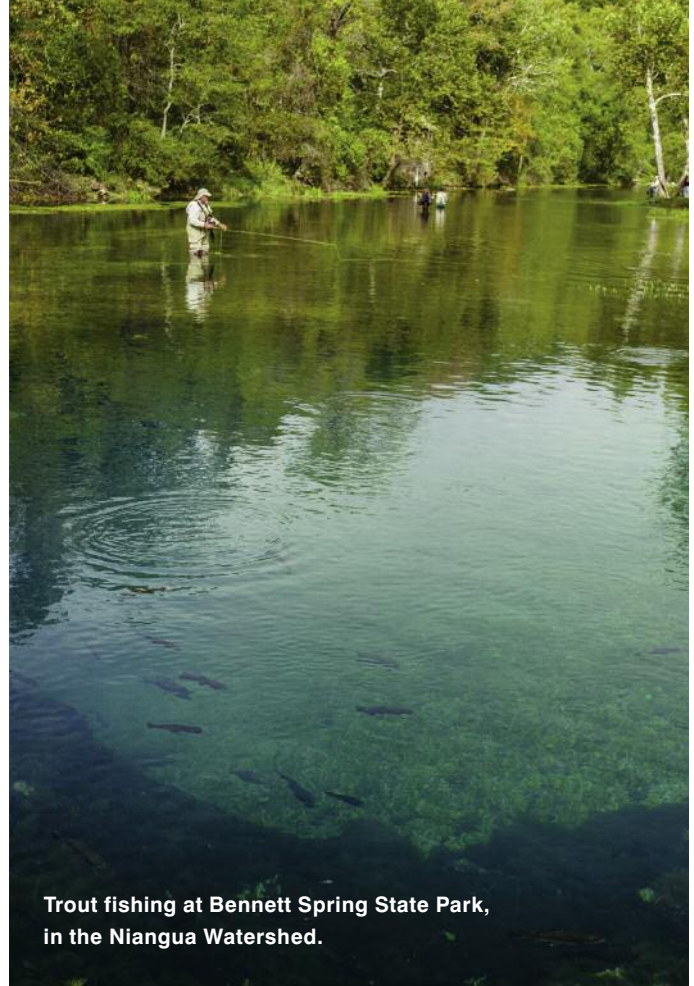
The priorities include: Our Missouri Waters, Community Services, Compliance Assistance and Youth Education.

Our Missouri Waters

- Missouri's waters are as diverse as the very landscapes they flow through. Missouri is fortunate to have rich natural resource diversity and abundance, which plays a major role in the state's overall health and economic well-being. To maximize planning for our water resources, the department is implementing an innovative watershed planning effort called Our Missouri Waters. This statewide plan focuses the department's water resource management efforts while increasing public engagement, better targeting fiscal, technical and information resources and providing greater protection to state waters.
- The department has created the framework to integrate all appropriate department resources and programs in a given watershed when addressing water resource management needs. This will maximize the department's efficiencies, resources and environmental benefits.
- One of the keys to this approach will be managing our water resources at the local watershed level – where specific water resource management needs are best addressed. The watershed-based approach will provide all partners and citizens with a common understanding of the issues and opportunities within the watershed. With the diverse hydrologic and multi-water-related resources to manage, it makes sense to be able to tailor our activities to the unique challenges and opportunities specific to each watershed.
- By coordinating our efforts with agencies and individuals who have an interest in the watershed, we can focus our staff and financial resources on priorities and on solving water resource problems. To learn more about Our Missouri Waters visit dnr.mo.gov/omwi.htm.

Community Services

- Many small communities are losing population and struggle financially to keep up with infrastructure improvements. In addition, many of these communities do not have access to engineers and other technical staff to determine their needs and deal with the special challenges they are facing. The drought of 2012 brought into focus the significant challenges facing small communities' drinking water systems. In addition, tightening water quality standards aimed at addressing water quality impairments means many communities will need to upgrade their sewage treatment systems, and aging



Trout fishing at Bennett Spring State Park, in the Niangua Watershed.

infrastructure only compounds this issue. These challenges have created an opportunity to take a fresh look at how the department works with communities, providing technical expertise to assist them in planning for their future.

- The department is retooling its financial assistance in order to serve communities in a more holistic manner. Where traditionally the department has focused on reacting to communities' financial needs for water and wastewater infrastructure, the department is seeking to be more proactive in working with small communities. The department will increase its level of customer service by getting its staff out into communities to provide direct technical assistance in planning for infrastructure and other environmental needs.
- The department also is partnering with regional planning commissions, water associations and other groups with specific skills and equipment to help communities gain access to expertise to better manage their drinking water and wastewater infrastructure.
- The department also has expanded the availability of engineering grants and other tools, such as schedules of compliance and findings of affordability, to help these communities make decisions on their infrastructure needs. Having these conversations and making these decisions together builds trust and enhances a community's ability to meet its challenges. It also provides a community the predictability needed to move forward to implement the upgrades and improvements necessary to protect the state's water resources.

Compliance Assistance

- The department firmly believes the path to achieving the best and most sustainable environmental quality is through enhancing compliance assistance efforts. Not only does a robust compliance assistance program decrease violations, but it is a more proactive way to achieve positive environmental outcomes that is far superior to an entirely reactive, solely enforcement-based approach. This has a secondary effect of increasing trust between the department and the regulated community. A business or community that trusts the agency is more likely to call and ask for assistance before problems occur.
- Many of the changes the department is undergoing will allow it to reallocate regional office staff efforts toward providing more compliance and technical assistance and public outreach. These include centralizing water pollution permitting and electronic permitting. Centralizing permitting will also have the benefit of improving efficiency of the overall permitting effort, and increasing consistency in how permits are crafted.



Students learn about phosphorescent dyes used in groundwater studies through the Missouri Department of Natural Resources' educational efforts.

Youth Education

- The department has an inherent role in educating Missourians about our natural and cultural resources. Encouraging youth to engage, participate and learn about nature and the resources that affect their quality of life is an important theme in the department's youth education effort.
- The department is reinvigorating its education strategy to work in concert with other agencies and initiatives and meet the curriculum needs of Missouri educators. The department will provide knowledge and tools to teachers, leaders and youth, promote the department's mission, stewardship of Missouri's natural resources, and encourage everyone involved to live a healthy and enjoyable outdoor lifestyle.
- This effort will build on successful education and interpretive programs already established within various areas of the department and will expand efforts in these

following program areas:

- Prioritize, develop and implement education resources for schools, teachers and youth leaders.
- Increase capacity within the agency for education program delivery.
- Partner with organizations and agencies that can assist in implementing our education goals, share our mission and also promote the missions of our partners.
- For more information about the department's education and interpretive programs visit the Web at dnr.mo.gov/education/index.html and watch for updates and new opportunities.

Each of the priorities serves one or more critical constituencies of the department and builds upon existing relationships. These priorities are designed to improve the way the department delivers services to its customers. In some cases the transformational priorities will focus services in new areas, such as assistance to Missouri's smaller communities and youth education.

The department's foundational activities include: Strategic Financial Planning, Succession Planning, Enhancing Science and Technology, IT Governance and Department Assessment Improvement. The activities serve to support the transformational priorities, as well as the many ongoing core department functions and strategic efforts.

The department's key messages will ensure its mission, vision and strategic priorities are related in such a way that will help engage the support of its constituents and demonstrate how the agency provides a benefit to the citizens, businesses and communities of Missouri.

Of course, the core functions of each division and program within the department continue to be of critical importance to the mission and vision of the agency. These priorities will help support this work and encourage collaboration among staff and the department's many external partners. The priorities, activities and functions, when combined, form the basis of the department's strategic planning efforts.

The department will continue to modernize the way it conducts business, both internally and externally, to improve the use of the state's resources, leverage technology and provide for more structured strategic decision-making in all facets.

The department will be able to provide a targeted approach to solving perceived or real problems and identify issues and opportunities for the department to pursue. These initiatives will foster an approach and decision-making that are based in science, allow flexibility for specific conditions and take stakeholder input into account.

The department remains committed to increasing communication to its stakeholders through a variety of existing methods and employing new tools and methods where most effective. Establishing common goals and objectives will help ensure the department is breaking through silos and providing the best service to the citizens and businesses of Missouri.

Implementation of these priorities will not occur overnight. The entire process will require time as the department's approach evolves, using lessons learned from current and past efforts. In addition, the department will learn from pilot programs.

Together, we can help make Missouri an even better place to live, work and enjoy the outdoors!

Our Air Resources

Protecting and enhancing air quality is a challenging responsibility requiring participation from state and local governments, regulated entities and the general public. Urbanization, industrial development and the increasing use of motor vehicles has prompted the federal government to tighten air quality standards to levels that are more protective of public health and the environment.

Air Quality Standards

We judge air quality using the National Ambient (outdoor) Air Quality Standards (NAAQS) established by the U.S. Environmental Protection Agency (EPA) under the federal Clean Air Act. Ozone, sulfur dioxide, fine particles and lead are some of the pollutants of concern in Missouri.

In addition, the state continues to follow nationwide developments to encourage the reduction of greenhouse gas and mercury emissions.

Ground-Level Ozone

Naturally occurring ozone in the upper atmosphere protects the earth from the sun's harmful rays. Ground-

level ozone is an irritant that damages lung tissue, aggravates heart and respiratory disease and can even cause problems for healthy individuals who spend a lot of time outdoors. It is also harmful to plants and trees. This pollutant is the most harmful part of what we sometimes call "smog."

Ozone is not directly emitted into the air. It forms on hot, stagnant summer days as sunlight causes a chemical reaction between nitrogen oxides and volatile organic compounds. Vehicles, power plants and industrial boilers are common sources of nitrogen oxides. Gasoline-powered vehicles and manufacturing are major sources of volatile organic compounds that can create ground-level ozone.

EPA strengthened the National Ambient Air Quality Standards for ozone in 2008 to an eight-hour average concentration of 75 parts per billion. The only areas of the state that EPA designated nonattainment are St. Louis, St. Charles, Jefferson and Franklin counties and St. Louis City.

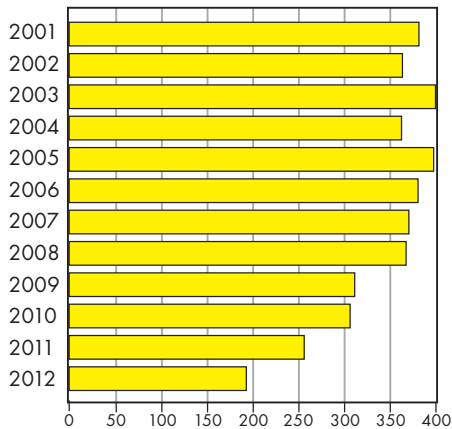


Vehicle exhaust is a major contributor to ground-level ozone, especially in metropolitan areas.

Air Emissions

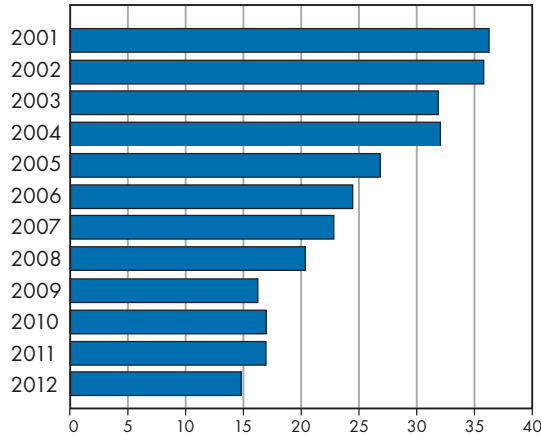
Sulfur Dioxide

thousand tons per year



Volatile Organic Compounds

thousand tons per year



Sulfur Dioxide –

Sulfur oxides are produced by burning sulfur-containing fuels such as coal and oil, by smelting metals and by other industrial processes. Sulfur dioxide (SO₂) makes up about 95 percent of these gases.

Airborne Lead –

In Missouri, airborne lead and its compounds are produced mainly by lead smelters.

Carbon Monoxide –

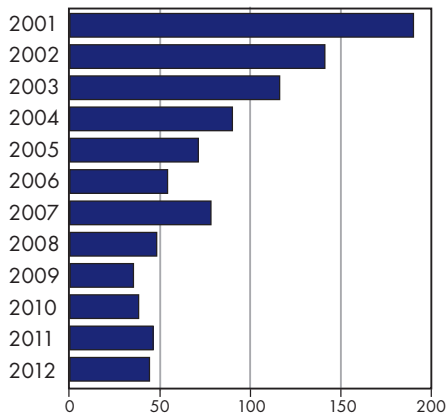
Carbon Monoxide (CO) is a colorless, odorless, poisonous gas that forms when carbon in fuels is not burned completely. It is a byproduct of vehicle exhaust.

Volatile Organic Compounds (VOCs) –

Volatile organic compounds react with nitrogen dioxide (NO_x) on hot summer days to form ground-level ozone. Vehicles, power plants and industrial boilers are common sources of nitrogen oxides. Gasoline-powered vehicles are a major source of VOCs.

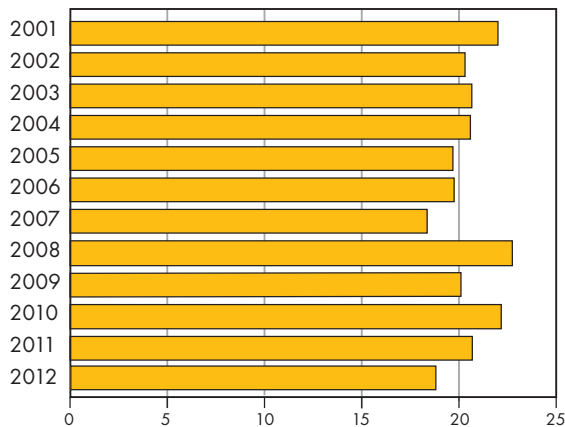
Airborne Lead

tons per year



Particulate Matter (PM₁₀)

thousand tons per year



Particulate Matter

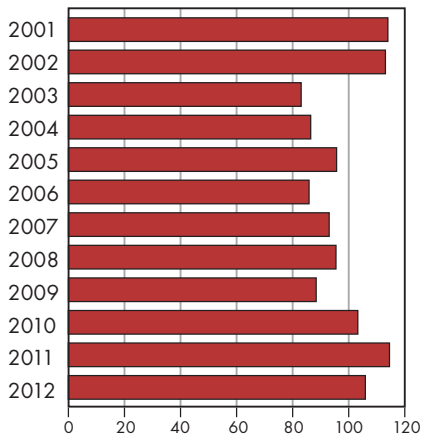
(PM₁₀) – PM₁₀ is particulate matter smaller than 10 micrometers and is frequently found near roadways and dust-creating industries.

Nitrogen Dioxide –

Almost all nitrogen dioxide is man-made. If fuel is burned above 1,200 degrees Fahrenheit, airborne nitrogen forms highly reactive nitrogen oxides such as nitrogen dioxide. Principal sources are power plants, industrial boilers and vehicles.

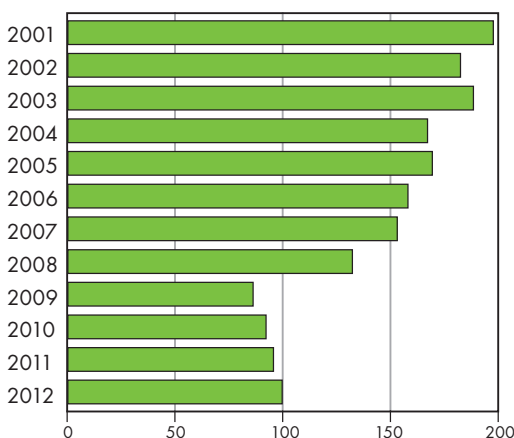
Carbon Monoxide

thousand tons per year

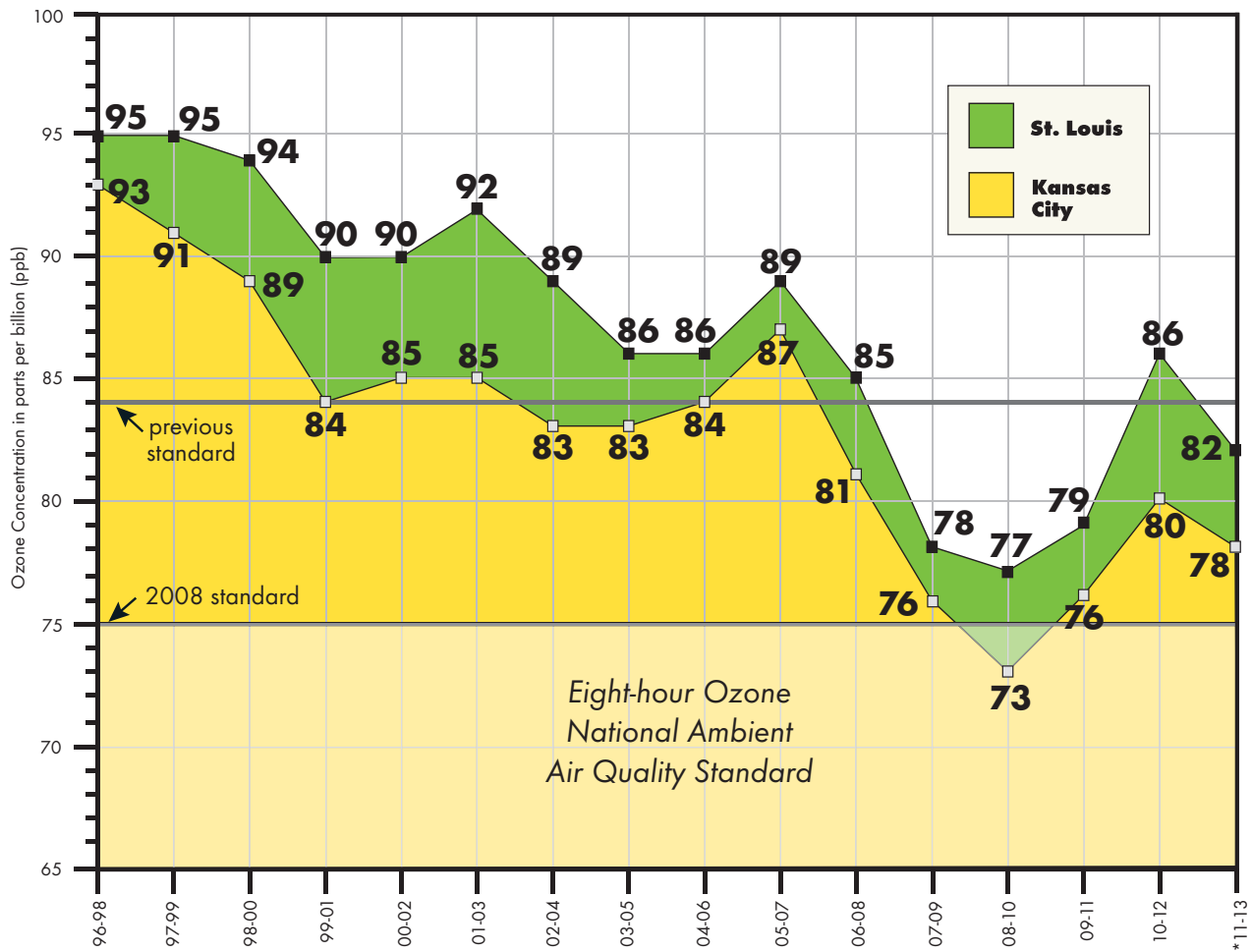


Nitrogen Dioxide

thousand tons per year



1996-2013 8-Hour Ozone Design Value Trends St. Louis and Kansas City Areas



*Quality Assured Data Through Oct. 31, 2013 (the ozone monitoring season)

Source: Environmental Protection Agency Air Quality System (EPA AQS), AMP 480 Report 02/26/2014

The plotted values represent an average of three consecutive years of ozone monitoring data for air quality monitors in St. Louis and Kansas City. The air quality monitor with the highest averaged value sets the ozone value for the entire area. If that value exceeds 75 parts per billion, a violation of the eight-hour ozone standard occurs. The area ozone values are plotted on the last year of the three-year period.

The U.S. Environmental Protection Agency set the National Ambient Air Quality Standards for ozone at an eight-hour average concentration of 75 parts per billion in 2008. EPA is set to release a proposal for a new ozone standard in December 2014, finalizing the new standard in late 2015. Based on 2011-2013 ozone monitoring data, 11 monitors in the state are violating the current standard. The state will address these monitors when addressing EPA's new, and most likely lower, ozone standard. For more information, see Ground-Level Ozone entry on page 4 of this section.

However, ozone has now become a public health concern in other parts of the state. As the science of ozone pollution's effect on public health continues to evolve, EPA may determine the standard needs to be made even more protective. If this occurs, it may be necessary to further reduce pollution in other areas of the state such as the Kansas City, Joplin and Springfield areas.

The state will continue to work on plans to outline how Missouri will reduce pollution in the current designated nonattainment area.

Current air pollution control efforts in Springfield and state plans for St. Louis and Kansas City will remain in place as the state evaluates what additional options may be necessary when EPA further strengthens the ozone standard

to reduce harmful emissions and protect public health.

Missouri citizens can also take voluntary actions to reduce their impact on the state's air resources. Simple, everyday steps can be taken to protect air quality and save money while doing it.

These steps, as well as other information and related topics are available on the Web at dnr.mo.gov/env/apcp.



Anti-idling efforts are increasing across Missouri to reduce engine combustion particulates in concentrated areas, such as schools.

Sulfur Dioxide

The largest sources of sulfur dioxide (SO₂) emissions are fossil fuel combustion at power plants (73 percent) and other industrial facilities (20 percent). SO₂ is linked with a number of adverse effects on the respiratory system. EPA first set two health-based NAAQS for SO₂ in 1971 at 30 ppb evaluated over an entire year and 140 ppb measured over 24 hours. In June 2010, EPA tightened the standard intended to protect the public against health effects experienced at shorter-term exposures. The new SO₂ standard is 75 ppb measured over 1 hour. Portions of Jackson County in the downtown Kansas City area and Jefferson County in the Herculaneum area were recently designated nonattainment for the 1-hour SO₂ standard. The department is working on plans to bring these areas into compliance with the standard by October 2018.

Particulate Matter

Particulate matter (PM) is a mixture of extremely small particles and liquid droplets made up of a variety of components, including acids (such as nitrates and sulfates), organic chemicals, and soil or dust particles. Particulate Matter can be even further defined by particle size as fine or coarse.

Both fine and coarse particles pose health problems because they can bypass the body's natural defense mechanisms and affect both the heart and lungs. Particles can affect the

health of everyone but primarily affect children, elderly, and individuals with asthma and cardiopulmonary disease.

PM₁₀ is particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers in diameter. PM₁₀ includes both the fine and coarse particle size fractions.

Coarse particles are inhalable and are between 2.5 and 10 micrometers in diameter. Coarse particles are usually found near roadways and dusty industries and typically do not transport as far as fine particles.

Fine particles, or PM_{2.5} are also inhalable and less than 2.5 micrometers in diameter. These particles can form when gases emitted from power plants, industries and automobiles react in the air. They can also be directly emitted from specific actions such as burning oil, coal, wood or residential waste.

In December 2012, EPA lowered the annual PM_{2.5} standard from 15 to 12 micrograms per cubic meter (µg/m³). No Missouri monitors currently violate this standard, but two monitors located on the Illinois side of the St. Louis area are currently in violation of the lower PM_{2.5} particulate standard.

Lead in Missouri

Airborne lead and its compounds come primarily from lead smelters. Airborne lead poses the greatest danger to children age six and under. Lead emitted into the air can be inhaled or, after it settles out of the air, can be

ingested. Ingestion is the main route of human exposure. Once in the body, lead is rapidly absorbed into the bloodstream and can affect many internal organ systems.

Low doses of lead can damage the central nervous system of children and fetuses leading to seizures, decreased IQ and behavioral disorders. In children and adults, increased blood-lead levels also cause fatigue, disturbed sleep, decreased fitness and damage to kidneys and blood-forming organs. Current health effect evidence does not indicate that any level of lead exposure is safe.

In October 2008, the EPA strengthened the standard from 1.5 to 0.15 micrograms per cubic meter. The revision is expected to improve air quality and public health for at-risk groups, especially children.

Herculaneum city and an area encompassing portions of Dent, Iron and Reynolds counties are nonattainment areas for the lead National Ambient Air Quality Standard. The department continues to work with the owners of the lead smelters in these areas on plans to implement process changes and control measures for achieving compliance with the lead standard no later than December 2015.

Greenhouse Gas

Federal actions concerning climate change have made greenhouse gases a more prominent topic of discussion. Combustion processes such as burning



The St. Louis riverfront, as seen from the Eads Bridge, a National Historic Landmark.

coal, diesel fuel, gasoline, natural gas, wood and waste materials emit greenhouse gases, such as carbon dioxide.

The two largest sources of greenhouse gas emissions are coal combustion at power plants and petroleum combustion by motor vehicles. The President's Climate Plan in June 2013 directed EPA to propose carbon pollution standards for new and existing power plants.

Vehicle Inspection and Maintenance Update

The Gateway Vehicle Inspection Program, or GVIP, is a decentralized On-Board Diagnostic-only vehicle emissions program required by state statute 643.303 RSMo. The GVIP requirements

apply to vehicles registered in St. Louis City, and Franklin, Jefferson, St. Charles and St. Louis counties.

The GVIP tests 1996 and newer vehicles with the OBD test to ensure vehicles are operating as cleanly as possible. Preventing the release of several harmful vehicle emissions helps to protect air quality for the region.

More than 800 independently owned businesses in the St. Louis ozone nonattainment area have been licensed to conduct the OBD emissions testing, in addition to the statewide vehicle safety inspection, on a biennial basis. The joint testing allows vehicle owners to go to one location.

Approximately 700,000 vehicles in the St. Louis nonattainment area receive

an OBD emissions test each year.

Test results are transmitted to the Department of Revenue on a real-time basis via a secure website, thereby allowing paperless verification of inspection results at all license offices and for all online registrations.

The paperless verification process provides an additional convenience to St. Louis area motorists and helps to reduce operation costs for the state of Missouri. The Gateway Vehicle Inspection Program is a key component in the ongoing effort to improve air quality in the St. Louis region.

For additional information on vehicle emissions testing in the St. Louis region, visit the department's website at: GatewayVIP.com.

CHALLENGES: Protecting Our Air Resources

- The department continues to monitor ambient lead levels around lead processing facilities. The department revised the state's current plan to ensure these areas achieve attainment of the current lead standard.
- In Missouri, major metropolitan areas like Kansas City, Springfield and St. Louis face the greatest threat from ground-level ozone. The department continues to monitor ozone levels throughout the state to verify compliance with the current ozone standard and plan for a potential lower ozone standard by the end of 2015.
- EPA published new federal regulations concerning Stage II Vapor Recovery at gasoline dispensing facilities. The department is working closely with stakeholders and other state/federal agencies to ensure the decommissioning of the current Stage II program in the St. Louis area proceeds appropriately and the Stage I Vapor Recovery program maintains the protection of the air quality in the St. Louis nonattainment area.
- New EPA monitoring proposals for sulfur dioxide (SO₂), nitrogen dioxide (NO₂), and particulate matter PM_{2.5} (2.5 microns in diameter and smaller) related to the revised NAAQS for those pollutants will require the department to implement additional monitoring sites over a period of time. Three near-roadway NO₂ monitoring sites are expected to be completely operational by January 2015. Additional point source or area wide sulfur dioxide monitoring may be required pending a new EPA Data Requirements Rule. The need to conduct analysis to determine site locations, acquire lease agreements for the properties, purchase equipment and install sites will require considerable effort from the department.

Our Geologic Resources



Rare Earth Elements, found in Missouri, are important for green technologies and defense applications.

USDA photo by Peggy Greb

Since 1853, the department's Missouri Geological Survey has provided reliable scientific information to describe and understand Missouri's wealth of natural resources. The department provides information about the characteristics of the state's geology that is essential for informed decision making, environmental protection and economic development that enhance and protect our quality of life.

Oil and Gas in Missouri

Oil and gas production in Missouri began shortly after the Civil War, primarily through the conventional technology of pumping liquid oil from a drill hole. Although not a leading producer of oil and gas, Missouri has significant reserves of "unconventional" resources. Oil and gas extraction technology is advancing rapidly; as a result, interest in Missouri oil and gas deposits has increased, particularly as the methods to extract these resources become more economical. Oil and gas resources that were considered too costly to produce as recently as 10 years ago are now being produced in the state.

In 2013, the Missouri Geological Survey issued 618 drilling permits.

In just 10 years, the number of operating oil and gas production wells in Missouri increased from 205 to nearly 1,000 in 2013. Oil production operators produced 183,002 barrels of oil, worth more than \$15 million, from existing Missouri deposits in 2013.

The quantity and quality of untapped unconventional oil and gas resources in Missouri is largely unknown. Potential energy resources in the state include coal, coalbed methane, oil, heavy oil, oil shale, oil sands and conventional gas. The Missouri Geological Survey collects and distributes scientific information about the availability, quantity and quality of the state's oil and gas occurrences. Read more at dnr.mo.gov/geology/geosrv/ogc/.

Minerals – Critical to Society

Modern society is wholly dependent on the knowledge of and access to the earth's available resources. The National Mining Association estimates that to maintain the current standard of

living nearly 48,000 pounds of minerals and mineral fuels must be provided every year for every person in the United States.

Documented mineral production in Missouri dates to the 1700s when French explorers mined lead in southeast Missouri. Since that time, lead has played an important role in the growth and development of Missouri. Lead mining hastened the settlement of the wilderness, affected the building of roads and railroads, generated a growth in commerce and industry and created an economic base for generations of Missourians.

Today, Missouri continues to be a national leader in the production of industrial mineral commodities. Industrial minerals are produced in almost every county in Missouri and are an important contributor to the state's economy, producing hundreds of millions of dollars in economic impact. The National Mining Association estimates Missouri's mining operations provide direct employment to 16,850 people and another 32,440 individuals indirectly from mining activity occurring both in

and outside the state for a total of 49,290 jobs statewide.

Minerals are used in a wide range of applications such as construction, clean air technology, clean water technology, pharmaceuticals, glass production, steel production, food production, paper manufacturing, infrastructure, agriculture, hybrid vehicle applications and corrosion protection of infrastructure. Rare metals are used in photovoltaics, laser diodes and medical research. Investment in the characterization and knowledge of Missouri's natural resources can lead to advantageous positioning in relation to emerging issues such as renewable energy, magnetics, semi-conductors and metal for economic development, technological growth and next-generation jobs.

Routinely ranking as one of the nation's top mineral producers, Missouri has a long history of minerals and energy production that includes lead, zinc, iron, copper, silver and industrial mineral commodities. With a geologic wealth of minerals, the state has benefited from a competitive advantage in the extraction industries for many decades.

Missouri is a leading producer of U.S. limestone commodities. Technological advancements have created renewed interest in Missouri's mineral resources of iron, rare earth minerals, oil and gas.

Access to metallic minerals is rapidly becoming a global economic issue.

Demand for these resources is ever-increasing as developing nations move toward modernization and new technologies reach market economies in support of advancing applications and national security.

Read more about Missouri minerals at dnr.mo.gov/geology/geosrv/geores/gdamhp.htm.

Natural Hazards

Missouri experiences geological hazards including, but not limited to, earthquakes, catastrophic sinkhole and mine collapse, landslides, swelling soils and flooding. The Missouri Geological Survey investigates geologic hazards and provides science-based information for emergency planning, mitigation and response coordination that will help protect public safety, security and economic health.

The New Madrid Seismic Zone (NMSZ) is one of the most active seismic zones east of the Rocky Mountains. A mod-

erate-sized earthquake could result in considerable damage to infrastructure. Most Missourians are familiar with the large 1811-1812 earthquakes that occurred in the NMSZ in southeast Missouri, but aren't aware that Missouri experiences small earthquakes nearly every day. These earthquakes, typically too small to be felt, are recorded on seismographs, devices that measure the earth's movement. While these earthquakes are more frequent in the NMSZ, they also occur on other faults located in Missouri and surrounding



Stormwater runoff passing through an illegal dumpsite in a sinkhole enters groundwater resources, re-emerging as contaminated water, often many miles away.

Silver Anniversary for McCracken Core Library and Research Center

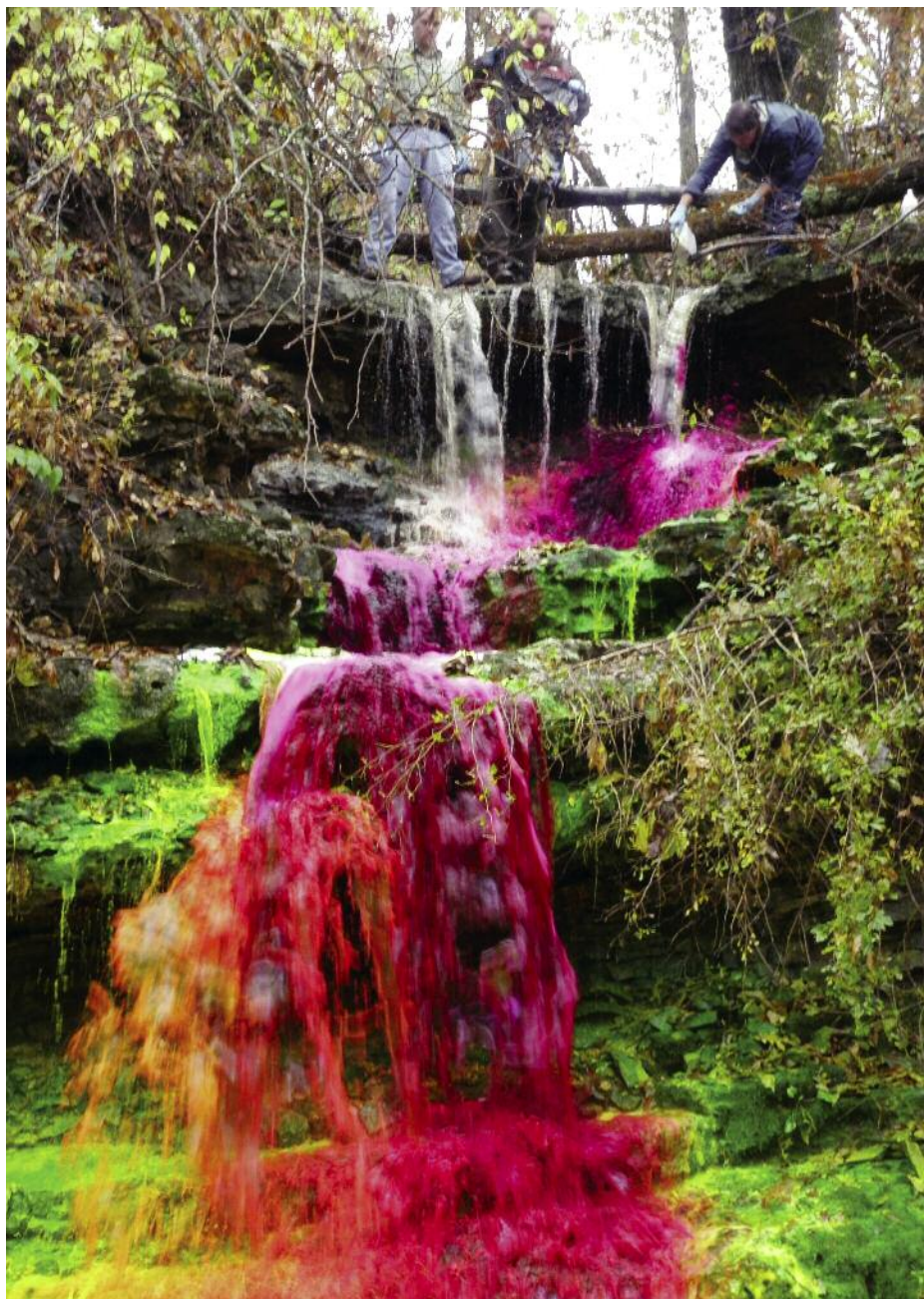
The Missouri Geological Survey's McCracken Core Library and Research Center is a valuable repository of geologic information. Named in honor of geologists Earl and Mary McCracken, this 21,000 square-foot facility contains one of the largest public collections of exploration rock core and drill cuttings in the nation. Dedicated Oct. 13, 1989, the library serves as a repository for more than 2.5 million linear feet of core and cuttings from more than 3,000 drill holes in Missouri. The estimated cost of replacing this core at current drilling prices would be approximately \$125 million. The information housed in this facility is of tremendous scientific importance and economic value to the state of Missouri.

The information provided by this core has aided in the completion of many investigative projects and research publications that may not have otherwise been attainable. The resources contained within the McCracken Core Library and Research Center assist federal and state agencies, schools and universities, private companies and local governments, protect the environment, save money, promote employment opportunities, and further advance our understanding of Missouri's geology and water resources.

Learn more at dnr.mo.gov/geology/geosrv/geores/mccracken.htm.

Bedrock core and drill cuttings are used in:

- Characterizing Missouri geology and hydrology.
- Determining the permeability, porosity, and composition of aquifers.
- Assessing the economic potential of Missouri's energy and mineral resources.
- Selecting sites for highways, bridges, dams, waste treatment and disposal facilities and other infrastructure.
- Assessing geologic hazards such as earthquakes, landslides and catastrophic sinkhole collapse.
- Conducting climate change research.



A water tracing project using dye, such as this one, confirmed that the source of water pollution at an Ozarks spring was the dumpsite shown on the previous page.

states. Thirty-five percent of Missouri business and homeowners expend an estimated \$80 million in earthquake hazard insurance premiums each year.

Sinkholes are depressed or collapsed areas formed by dissolution of carbonate bedrock or collapse of underlying caves. Much of Missouri, especially the Ozarks, is underlain by bedrock susceptible to sinkhole development. The Missouri Geological Survey has verified more than 16,000 sinkholes in Missouri. Sinkholes are part of what is called "karst" topography, which also includes caves, springs and losing

streams. Aside from structurally impacting foundations of homes and other buildings, sinkholes often serve as direct conduits for rapid surface water infiltration into the underlying groundwater aquifer.

Contaminants near or at the surface can quickly enter the aquifer and pollute an area's drinking water supplies.

Landslides, slumps and rockfalls are potential geologic hazards throughout Missouri. They are often triggered when surficial materials are disturbed or modified by man. Rockfalls are common hazards in areas that have bluffs or

extremely steep hillsides. Landslides and rockfalls can vary in size from small to very large. In general, the higher and steeper the slope, the farther and faster the landslide or rockfall will travel.

Although man-made, collapsing mines also pose a geologic hazard. Abandoned mines occur throughout Missouri and include both surface pits and underground workings. Old mines are typically abandoned without proper reclamation or closure. These pits and underground voids can pose a public safety hazard.

Understanding the potential risk from seismic and other associated geologic hazards is necessary for the department to provide the last available information and guidance to community leaders and the public. The overall catastrophic impact within communities can be reduced by identifying geologic hazards that are co-located with critical facilities and using this information to effectively focus resources for current and future use. Learn more about natural hazards at dnr.mo.gov/geology/geosrv/geores/geohazhp.htm.

Protecting Missouri Groundwater

Missouri has significant, high quality groundwater resources. The Missouri Geological Survey identifies and evaluates the availability and use of groundwater, utilizing geologic science to ensure protection of critical groundwater resources from potential contaminants to safeguard availability for current and future use. Missouri has 159,180 water wells of which 133,462 are private domestic water wells. Each year approximately 3,100 private domestic water wells are drilled and 250 are plugged.

Municipalities and businesses in the state operate more than 4,300 public wells, some supplying as much as 2 million gallons of water each day.

Groundwater is a resource that must be understood to ensure future availability. Because the state's geology is mostly composed of porous sedimentary rocks like sandstone and fractured limestone and dolomite, it is capable of storing a lot of groundwater. In fact, much of Missouri contains an abundance of fresh, drinkable groundwater available for use. Several billion gallons of groundwater are pumped from the state's geologic formations every year,



GeoSTRAT

The Missouri Geological Survey recently launched a Web application using ESRI GIS and Google Earth software to provide geoscience information in an easily accessible format to the public, business sector and other government agencies. The Missouri Geosciences Technical Resource Assessment Tool (GeoSTRAT) enables users to easily visualize and explore geospatial data using an interactive map that was developed on a 3-D globe for added visualization of the land surface. Data such as geology, water wells, sink-holes, historic mine locations, caves, springs, water traces, well logs, aquifers, groundwater information and losing streams can be displayed and downloaded in formats compatible with a variety of free and commercial mapping software.

GeoSTRAT is a convenient and powerful tool that can be used for site assessments in areas such as hazards, environmental consulting and engineering, emergency response, local and regional planning, insurance purposes, water planning and a multitude of other purposes. Access GeoSTRAT at dnr.mo.gov/geology/geostrat.htm.

and the demand will likely increase. We use groundwater for drinking, food production, cleaning, cooling, heating, manufacturing and recreation. The natural beauty of water is the central focus in many of our state parks and historic sites, and a focus area of protection for the department. Therefore, we are heav-

ily invested in this vital resource. Protection of groundwater resources hinges on our scientific understanding of aquifers. Many scientific methods of investigation are used to define characteristics of groundwater aquifers. Water tracing is one method the department uses for studying how groundwater can be influenced by human activity. Based on information derived from traces, certain aquifer characteristics are documented to help measure how vulnerable an aquifer may be to activities occurring on the surface. For 40 years, the department has upheld the Missouri Clean Water Law by protecting, maintaining and improving the quality of surface and groundwater in the state. The work is paying off and citizens enjoy the cleanest and highest quality water in Missouri in decades. To learn more about water tracing and private water wells visit dnr.mo.gov/geology.

Geologic Mapping

The Missouri Geological Survey conducts geologic mapping to provide a scientific foundation for a broad range of activities focusing on human health, the environment, natural hazards

and other hazards, emergency planning, energy and mineral resources, groundwater resources, land use planning, agriculture, economic development, education, public policy support, tourism and recreation. Geologic maps are tools that provide an interpretive, three-dimensional view of the rock, sediment and soil that make up our environment. These maps depict rock distribution, rock properties and its relative age relationship. They provide information about the Earth's structure and provide a baseline for data related to energy resources, mineral resources, natural hazards, water resources, soil conservation and climate science.

Virtually all mineral, energy, water, industrial construction, public works and urban development projects would benefit from data contained in a geologic map.

Geologic map-based information is essential to the evaluation of the vulnerability of watersheds to point source and nonpoint source contamination and helps landowners, farmers and government agencies locate groundwater resources. Geologic maps provide a basis for defining the occurrence and distribution of energy and mineral resources and are used to identify areas prone to natural hazards, as well as to identify sites that are suitable for construction of bridges, dams, tunnels, pipelines, highways and other infrastructure. In an effort to minimize environmental impact, geologic maps can be used to identify suitable sites for wastewater treatment and landfill construction. Geologic map-based information is essential to the evaluation of earthquake-related hazards and defining the potential for future earthquakes.

Geologic maps and their derivative products have enormous economic, societal and scientific value. Geologic mapping efforts undertaken since 1993 have established the potential for producing nearly \$200 million in economic value for Missouri.

Cost-benefit studies show the value of a geologic map is 25 to 39 times the cost to produce the map and that developers and engineers save about \$50,000 per project when modern geologic maps are available.

Visit this link for geologic map: dnr.mo.gov/geology/statemap/missouri-maps.htm.

Challenges: Protecting Our Geologic Resources

- Oil, gas and mineral resources continue to contribute to the economy of Missouri. The department must continue to balance economics and environment by ensuring extraction is conducted in a sustainable, environmentally sound manner.
- The department must continue to protect, maintain and improve Missouri's extensive water resources by providing scientific analysis for use in decision making.
- The department must continue to make technology work for Missourians by providing geologic data available online.

Our Land and Soil Resources



Our land sustains us by producing the fruits, vegetables and grains necessary to nourish our bodies and the timber that provides us shelter. The crops our land produces also are an important source of income for many in Missouri's rural communities. Damages to our land through soil loss or polluting our soil from improperly disposing of solid waste and hazardous waste can have far-reaching consequences. Minerals and rocks contribute to the economy of the state in a variety of ways. Some of these raw materials are key components in construction of roads, bridges, buildings, homes and numerous other products. In fact, mining is one of the largest economic incomes for the state. Limestone products are used in agricultural applications, pharmaceutical products, paper manufacturing,

paint, glass making, cement and pollution control technologies. From the forested Ozarks and rolling hills to the plains and prairies full of life, our land is an asset the Department of Natural Resources is committed to protecting and enhancing.

Soil Erosion

When soil enters Missouri's waters through natural or man-made processes, it can have a negative effect on aquatic life, drinking water and recreation. As soil is washed away from the land, pollutants such as pesticides and fertilizers are often carried with it. Some of these chemicals can remain in the water for long periods of time, and for long distances – in some cases all the way to the Gulf of Mexico. Implementing

effective soil and water conservation practices reduces pollutants that enter Missouri's streams, rivers, lakes and water supply reservoirs.

Although soil erosion is a natural event, certain farming methods can accelerate erosion. Many acres that were enrolled in the federal Conservation Reserve Program and marginal lands are now being cultivated for oil and grain production, accelerating the loss of soil on highly erodible fields. Currently the rate of soil erosion on cultivated cropland in Missouri is 5.5 tons per acre per year.

Missouri initiated the first in the nation Parks, Soils and Water Sales Tax, passed in 1984. Half of the tax fund supports the activities of the Soil and Water Conservation Program and the



Silt fences prevent soil erosion at construction sites from polluting local waterways and minimize topsoil loss.

remaining half supports Missouri State Parks. The citizens of Missouri recognize the importance of these efforts through the continued support of the tax, which was renewed in 1988, 1996 and again in 2006.

Missouri's soil and water program is a role model for the nation. Other states envy Missouri for its dedicated tax and support from citizens to promote good farming techniques that help keep soils on the fields and our Missouri waters clean.

Over the past 30 years, soil and water conservation programs have helped Missouri landowners keep more than 172.8 million tons of soil from

eroding into our waterways.

The Soil and Water Districts Commission has responded to the growing need to address water quality issues in addition to soil erosion. Agriculture is totally dependent upon water, and it in turn, has an effect on the quality and quantity of water leaving agricultural fields. Conservation practices applied to these fields improve water infiltration, and reduce runoff and soil erosion.

Funding to support Missouri's 114 county soil and water conservation districts helps landowners with technical and financial assistance to construct traditional practices to prevent soil ero-

sion, such as terraces, grassed waterways and ponds, and also to implement practices designed specifically to improve water quality. Properly implemented management practices, such as nutrient and pest management, and grazing systems will reduce runoff and result in improved water quality in Missouri's streams and rivers, and often result in reduced production costs for participating landowners. These erosion-control practices fight the loss of topsoil, which affects everyone – good soil is critical for food production.

Changes in business efficiencies and processes within the Soil and Water Conservation Program have allowed the

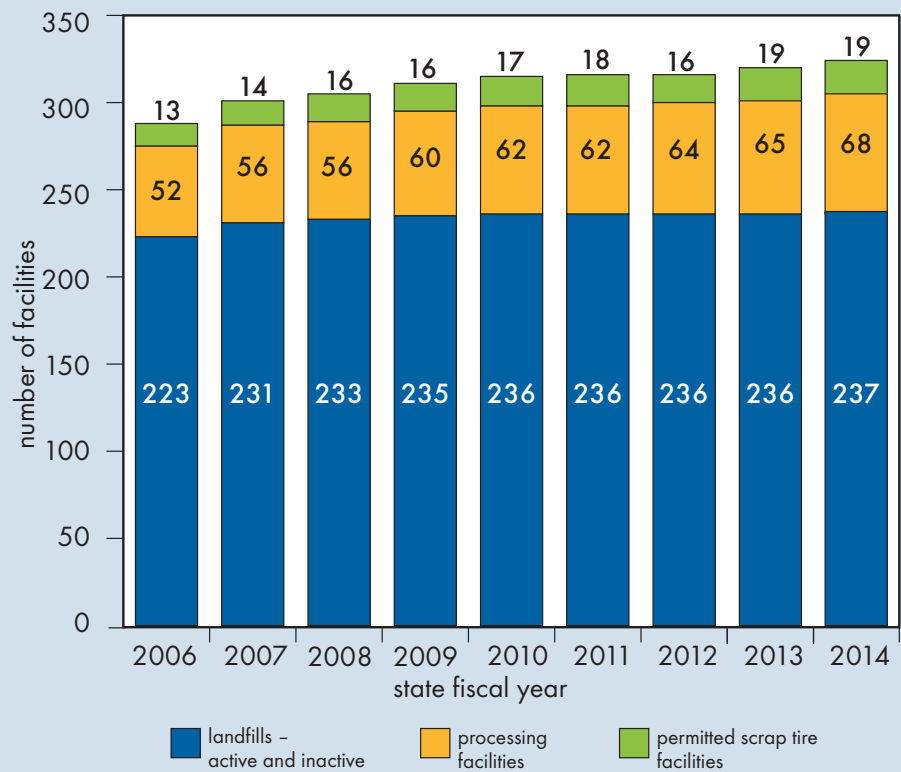
Conservation practices such as electric fencing exclude cattle from woodlands and other sensitive areas. This keeps manure on pastures where it benefits fertility and protects the sensitive area from trampling and pollution.



During the past 30 years, the department has provided \$612 million to landowners from the Parks, Soils and Water Sales Tax to protect our soil and water resources.



Regulated Solid Waste Facilities



department to increase the funding available to landowners while improving administrative and personnel support for local soil and water conservation districts.

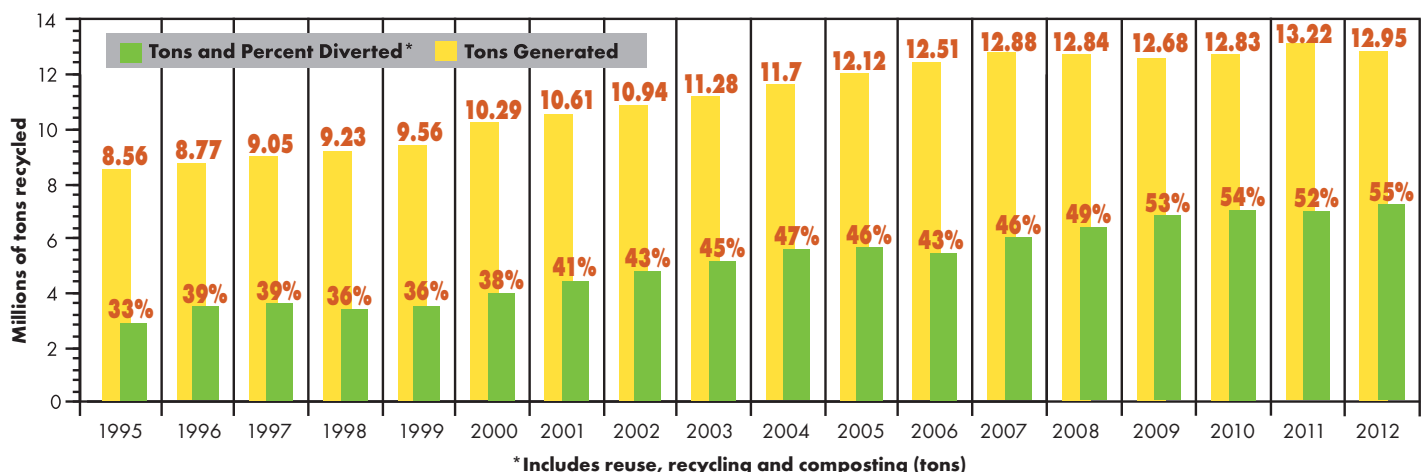
In fiscal 2014, the department's Soil and Water Conservation Program had made \$27.7 million

from the Parks, Soils and Water Sales Tax available for landowner incentives. More than 60 cents of every tax dollar dedicated to soil and water conservation will be used for erosion control and protecting our water resources through implementation of conservation practices. The largest portion of the remaining funds support the

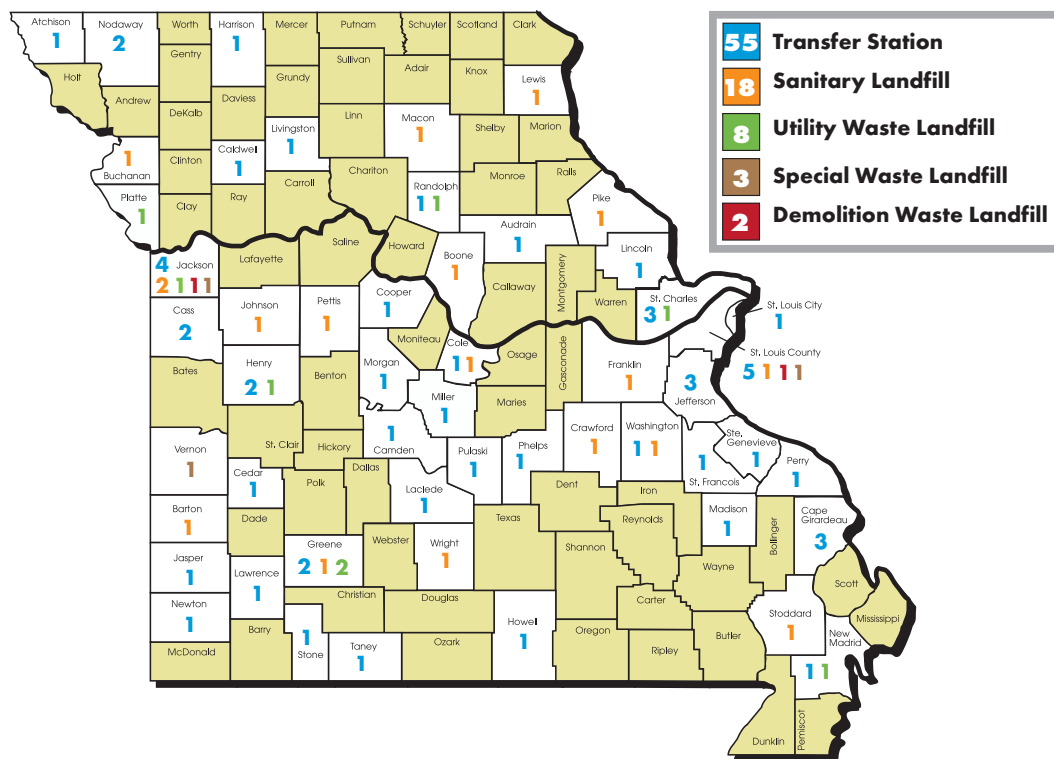
soil and water conservation districts.

Since 1984, the Department of Natural Resources has provided \$612 million to Missouri agricultural landowners to implement more than 210,000 conservation practices to protect the state's soil and water resources. In addition, revenues from the Parks, Soils and Water Sales Tax

Waste Generated and Waste Diverted From Missouri Landfills



Missouri Landfills and Transfer Stations



working with counties and cities, the department identifies new dumpsites. Routinely, through this process, another 250,000 to 300,000 tires are located each year in small illegal dumpsites, which are then added to the inventory of sites to be cleaned up. The remaining dumpsites are smaller in size, harder to find and are often located in hard to reach areas. These characteristics have slowed the cleanup of scrap tire dumpsites and have increased the unit cost per tire cleaned up.

The department's Tire Dump Roundup program assists in locating and expediting the cleanup of the remaining smaller dumpsites. The program provides an incentive to citizens to self-report scrap tire dumps on their property by allowing for a free cleanup of the scrap tires if the program's criteria are met. The basic program criteria require the sites to contain between 500 to 10,000 tires, the property owner must not be an operating tire generating business, and the property owner must sign an access agreement. The proper-

ty owner must agree to maintain compliance with environmental regulations for two years from the execution of the access agreement.

Additionally, the Tire Dump Roundup program was expanded by the department to include work with Missouri's 20 solid waste management districts to facilitate cleanups by nonprofit groups and to create staging areas for smaller dumpsites that contain less than 500 scrap tires.

Water standing in scrap tires provides an ideal breeding ground for mosquitoes, which are known to carry diseases such as the West Nile virus.

In 2006 and 2007, there were 139 reported cases of West Nile virus in Missouri. This number has continued to decrease considerably since that time – see chart on previous page.

Tire cleanups are funded by a 50-cent fee assessed on each new tire purchased in Missouri. The fee generates about \$2.1 million annually and helps the department oversee and support scrap tire cleanups from Missouri's

landscapes and countrysides. The statutory authority for the fee expired for a time beginning Jan. 1, 2004, and was reinstated in the 2005 legislative session. It was renewed in 2009 and again in 2014. The renewal enacted in the 2014 session carries a sunset date of Jan. 1, 2020.

When recycled properly, scrap tires have many beneficial uses. They can be made into playground surfaces, running tracks, recycled rubber products and can even be burned for fuel in power plants. From 2004 to 2013, more than 20 million scrap tires were used as tire-derived fuel in power plants. The department is also working with the Missouri Department of Transportation to promote the use of scrap tires in asphalt that is produced for Missouri road projects.

So a tire that was once a home for mosquitoes and other pests could become a belt or purse, protect a toddler from a nasty spill, help to light your home or even provide the road surface for you to travel on.



Missouri Hazardous Substance Site Locator

The department's new online map, the Hazardous Substance Site Locator at dnr.mo.gov/molts/gov/ serves as a central information resource about hazardous substance investigations. This website features an interactive map viewer with individual site status summaries from department's databases for most sites with links to important documents. It also includes data layers that local governments or utilities can download and use to assist them in their own permitting and planning efforts. The online site locator is designed to help ensure property is used safely in Missouri.

Many contaminated sites go through risk-based remediation, which means the site is cleaned up to a level sufficient for its likely future use. Such cleanups may include physical controls like barriers and caps or restrictions on future uses of the property. These sites need long-term stewardship to ensure the property is used appropriately and physical controls are maintained. Making information available to all who may be affected by contamination is a key part of the department's stewardship of such sites. Until now almost all this information was only available by reviewing department paper files and county property records. But we know many property uses that may put people at risk do not involve chain-of-title searches, such as construction and utility work. This website will provide all property users with a direct, central source for accessing information critical to their safety.

Hazardous Waste

Improper handling or disposal of hazardous waste poses a threat to public health and the environment. The Department of Natural Resources engages in three major functions related to hazardous waste: pollution prevention, environmental cleanup and long-term stewardship.

The department ensures compliance with laws and regulations designed to prevent pollution. The department also works with businesses that generate and transport hazardous wastes to ensure the materials are handled and disposed of properly. In 2012, Missouri companies generated about 261,074 tons of hazardous waste. Approximately 80 percent of this was treated or disposed of in Missouri; the remainder was shipped out of state or out of the country.

During this same period, Missouri received approximately 148,626 tons of hazardous waste from outside the state. About 92 percent of this imported waste was burned by Missouri cement making operations as a substitute for coal. The department also oversees the operation

of approximately 3,500 underground storage tank sites that include approximately 9,200 tanks.

The second major department function related to hazardous waste is environmental cleanup of contamination that is not caused by nature. The department implements laws ensuring parties responsible for contamination are held accountable for cleaning it up. The department also works with other entities seeking to voluntarily clean up contamination. In all cases, the department provides oversight for investigating and remediating contamination to bring these sites back into beneficial reuse, which provides economic benefit and results in more sustainable communities. Where appropriate, the department performs operation and maintenance activities to help assure that remedial actions taken at a site continue to be protective of human health and the environment. Examples include brownfields, gas stations, major oil refineries, abandoned lead mine sites, major industrial areas, wood treaters, Superfund sites, drycleaners, federally

owned sites and many others.

Because most corrective actions leave some residual contamination, the program implements measures to ensure that remediation decisions result in safe and productive reuse of properties for the benefit of future generations. This corrective action is known as a long-term stewardship.

Examples of long-term stewardship tools include engineered controls to isolate contamination, property controls to limit activities, governmental controls such as zoning or permits, informational devices and regular onsite environmental inspections.

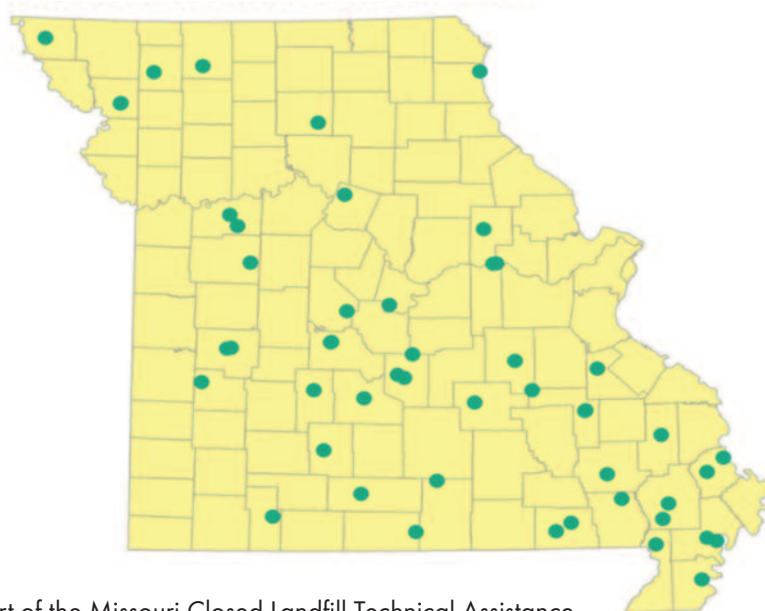
"No Stricter Than" Rules

In 2012, the Missouri General Assembly passed a statute requiring the department to compare the state regulations for hazardous waste management to the federal regulations in certain subject areas, and make any changes necessary to ensure state regulations are not stricter than requirements established in the federal regulations. The "no stricter than" statute for hazardous waste management is found in Section 260.373 of the Revised Statutes of Missouri.

The limitation applies to definitions, identification of hazardous waste, hazardous waste generators and permitted treatment, storage and disposal facilities. The limitation does not apply to hazardous waste transporters, used oil, universal waste, brownfields, Superfund or underground storage tanks. In addition to not applying to these subject areas, the statute includes some exceptions to the limitation on being no stricter than federal regulation. The primary exceptions are for generator thresholds, reporting of hazardous waste activities, hazardous waste fees, display of hazard labels on hazardous waste tanks and containers and for rules which are based on other state statutes that explicitly prescribe stricter state standards.

The regulations in the affected subject areas are all found in Title 10, Division 25, Chapters 3, 4, 5, and 7 of the Code of State Regulations (10 CSR 25). The Department of Natural Resources has completed the identification and review process for these chapters and is working on developing the proposed rule amendments that will implement the statutory changes.

Solid Waste Management Program Old, Closed and Abandoned Landfills Project



As part of the Missouri Closed Landfill Technical Assistance Project, the department's Solid Waste Management Program inspected 58 older, closed landfills in more than 40 rural counties throughout Missouri.

Radioactive Transportation Fee

Shipments of radioactive materials are subject to a Radioactive Transportation Fee (260.392, RSMo) when traveling in or through Missouri. These shipments include high-level radioactive waste, transuranic radioactive waste, highway route controlled quantity shipments, spent nuclear fuel or low-level radioactive waste. Missouri uses the fees collected to cover costs incurred by the state for activities related to the shipments, such as inspections, providing security escorts and oversight, and planning activities.

The Department of Natural Resources oversaw the shipment of 421 trucks and 798 railcars that transported low-level radioactive waste through Missouri during fiscal year 2014. There also were 33 highway route controlled quantity shipments of radioactive material transported through Missouri, which received escorts by the State Highway Patrol and radiological inspections by the Department of Health and Senior Services. This multiagency effort has provided training to more than 132 emergency first responders through eight different classes across the state. This training is focused on communities

along the major transportation corridors used by radioactive shipments, including interstates and some rail lines.

The Department of Natural Resources recently purchased radiation detection equipment using the transportation fee. Based on the number of first responder staff who attended training, first response organizations qualified for radiological detection equipment that will assist in detecting and measuring radioactive contamination at the scene of an incident. Ten first response organizations have received equipment, with eight more qualified for equipment in fiscal year 2015. Legislation was recently passed to extend the fee's sunset date from 2015 to 2024.

Resource Recovery Program

Missouri's Resource Recovery program encourages responsible recycling of hazardous waste using the best available technology and procedures. Missouri's resource recovery rule applies to facilities that reclaim or reuse hazardous waste or transform hazardous waste into new products.

Many Missouri manufacturing facilities use solvents to clean various parts

Missouri Closed Landfill Technical Assistance Project

Through file reviews and site assessments, the department examined 58 landfills throughout the state as part of the Missouri Closed Landfill Technical Assistance Project. The department's goal was to assist current and future owners of these properties to better understand the closed landfills they own and to be prepared to manage the site with little or no environmental impact to the surrounding community or property.

The focus of the project was two-fold: 1) assessing the condition of some of Missouri's older, closed, rural landfills, which operated under less stringent standards than modern landfills, and 2) providing technical assistance and training to counties, municipalities and individuals throughout the state who own the old disposal areas.

The guidance and training developed as a part of this project assists with landfill maintenance activities, informs real estate transactions involving property containing a landfill, and facilitates appropriate future use of the landfill property to ensure all surrounding land and water resources are safely and adequately protected.

and tanks after a production run. These solvents eventually become contaminated with the material they are intended to clean. After the solvent is spent and can no longer be used for its intended purpose, it becomes a hazardous waste and must be managed as such. Many facilities handling large amounts of solvent or paint waste use an on-site distillation system. This system filters out the impurities from the spent solvent so it can be reused in the manufacturing process or sold on the open market.

The majority of hazardous waste recycling in Missouri is accomplished through energy recovery. Two businesses in Missouri use a variety of blended liquid and solid hazardous waste-derived fuels to supplement the fuel needs for their cement kilns.

Hazardous waste-derived fuel can be in liquid or solid form and has a high-energy content. Hazardous wastes that can be made into fuel include solvents, organic liquids, paint residues, contaminated oil, byproduct fluids and other solid wastes contaminated with hazardous waste.

By using the blended hazardous waste-derived fuels as a alternative to fossil fuels in cement kilns, natural resources are conserved.

This recovery method reduces overall carbon dioxide emissions, avoids the use of hazardous waste landfills, decreases the need to incinerate hazardous waste and recognizes the energy value of the waste materials.

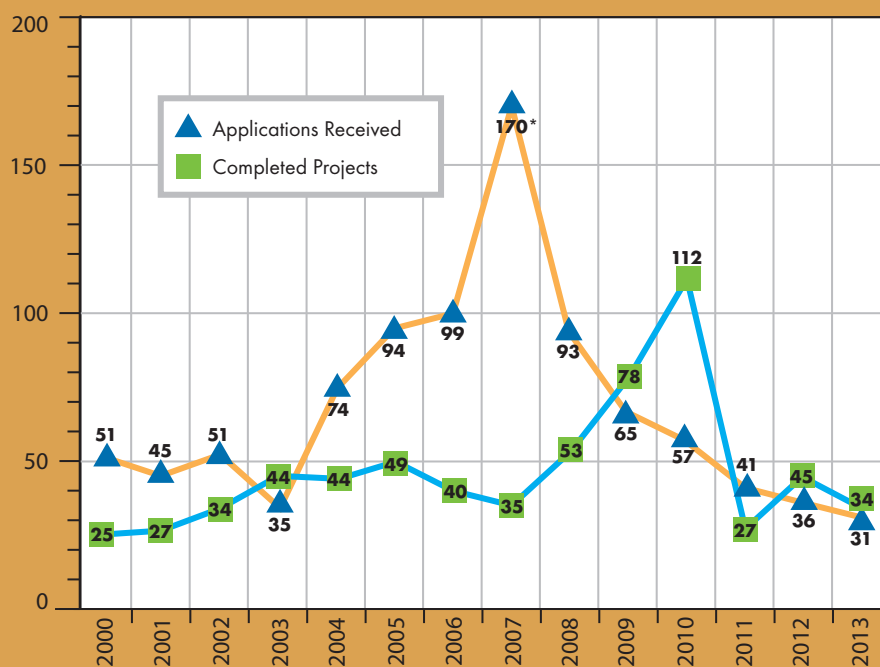
A new and innovative metals recycler recently received department approval to recover metals from industrial hazardous waste streams containing low concentrations of non-ferrous, precious and rare metals. Their patented EMEW® electrowinning equipment can recover nickel, copper, lead, tin and other metals from hazardous wastes as a high-grade pure metal. By recovering and reusing these metals, we reduce the need to mine for new raw materials, thereby conserving energy and natural resources.

E-cycle Missouri

The state and nation continue to struggle with how individuals and companies can best manage the growing number of electronic devices that are disposed of each year. Also known as e-scrap, this waste includes such items as outdated computers, monitors, key-

Brownfields/Voluntary Cleanup Program

Applications/Completions by Calendar Year 2000-2014



*The 170 applications received in 2007 were the result of a special effort to focus on brownfield cleanups. The number of applications has declined since that time and is largely attributable to the nationwide mortgage crisis that, beginning in 2008, caused decline in estate development activity.



Electronic devices contain hazardous materials and pose health risks when improperly disposed. E-cycling not only conserves resources and protects human health and the environment – it creates Missouri jobs.

boards and mice, printers, televisions, cell phones and other types of hand-held electronic devices. If not recycled or properly handled when they reach the end of their useful life, these devices can become hazardous waste.

Department staff, in coordination with many stakeholders, promote e-cycling and local Missouri businesses that can assist in this process. The department and its stakeholders support the recycling of used or outdated electronic equipment and the benefits of e-cycling, which include the protection of human health, maintaining a clean environment, creating local jobs, supporting local communities and conserving natural resources. For information and locations on where to e-cycle, visit ecyclemo.org.

Underground Storage Tank Inspections

Department staff conduct inspections of each new underground storage tank (UST) installation. This serves to ensure tanks and piping are installed correctly and safely in the interest of preventing catastrophic and costly petroleum releases. The inspectors verify that installations are performed in accordance with manufacturer's requirements and with state and federal regulations. The department's inspectors also provide technical assistance to owners and installers before, during and after instal-

lation. Staff coordinate with partners such as the Petroleum Storage Tank Insurance Fund, the Missouri Department of Agriculture, local agencies and the Department of Natural Resources' regional offices.

Missouri Pesticide Collections

During 2012, 2013 and 2014, the department's Hazardous Waste Program and Environmental Services Program staff oversaw a statewide pesticide collection program. The program was included in a Supplemental Environmental Project that was part of a larger settlement agreement to resolve a hazardous waste enforcement case. The department required the responsible party involved in the settlement to fund the program, which provided opportunities for farmers and households in Missouri to properly dispose of their waste pesticides and herbicides.

In 2012 and 2013, the department completed 17 collection events, collecting a total of 123,046 pounds of waste pesticides and herbicides. The department also hosted pesticide collections during 2014. Staff were present at each event.

The projects made possible by these events benefit citizens with safe, convenient pesticide waste disposal options and a cleaner, safer environment for their families and communities.

Missouri Risk-Based Corrective Action (MRBCA)

MRBCA is a flexible process to manage contamination based on the risks the contamination poses to human health and the environment, now and in the future.

- Cleanup based on risk.
- Risk dependent on exposure.
- Exposure dependent on contaminants, routes of exposure and established targets.
- Cleanup plans are flexible and tailored to address site-specific conditions and goals.
- Future risks are actively managed through robust long-term stewardship efforts.

Brownfields/Voluntary Cleanup Program

It is estimated there are more than 450,000 brownfields in the United States. Brownfields are abandoned, idled or underused industrial and commercial sites where expansion or redevelopment is complicated by real or perceived environmental contamination problems. Brownfields can be in urban, suburban or rural areas of the state.

Property owners, business operators or prospective buyers who want to clean up a property to standards acceptable to the department can enroll in the program.

The department issues a certificate of completion once the onsite contamination is cleaned up to levels safe for the site's anticipated use. This certification can greatly reduce the environmental liability associated with such properties, increase the property value and allow unused or blighted properties to return to productive use. In Missouri, 245 Brownfield/ Voluntary Cleanup Program sites are currently undergoing an investigation or cleanup. Since the BVCP's program's inception in 1994, 719 contaminated sites have been cleaned up and returned to productive use.

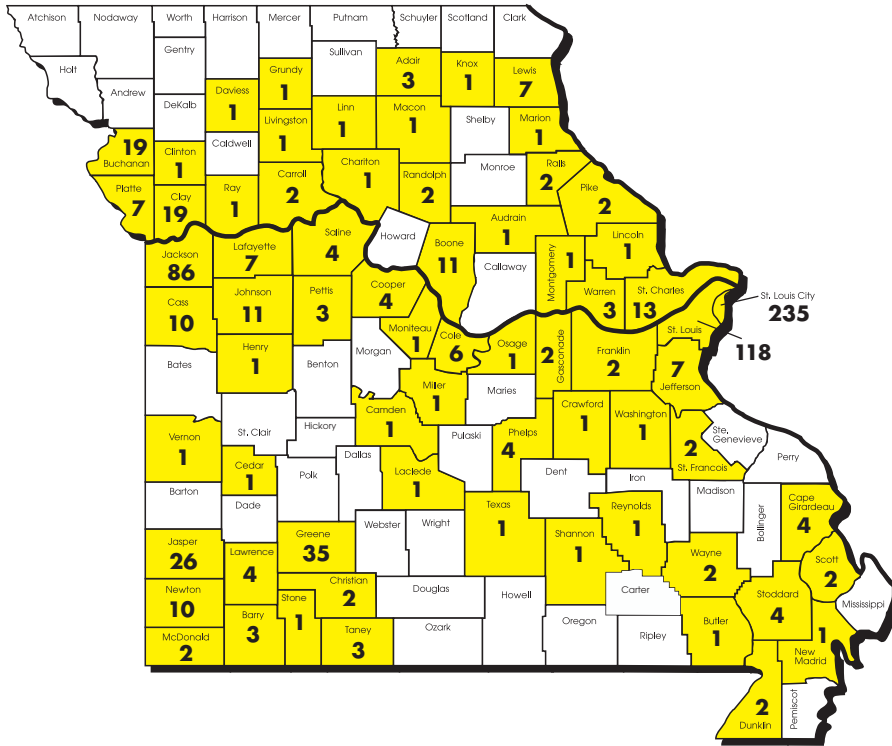
Drycleaners

The department administers the Drycleaning Environmental Response Trust Fund, also known as the DERT fund. The DERT fund is used to reimburse facilities for investigation, assessment and cleanup of releases of chlori-



The removal of underground storage tanks is part of the brownfield cleanup process.

Brownfield Certificates of Completion FY2013



nated solvents from Missouri dry cleaning facilities. To date, the fund has issued 15 certificates of completion and reimbursed \$2,411,983 in eligible costs to participants.

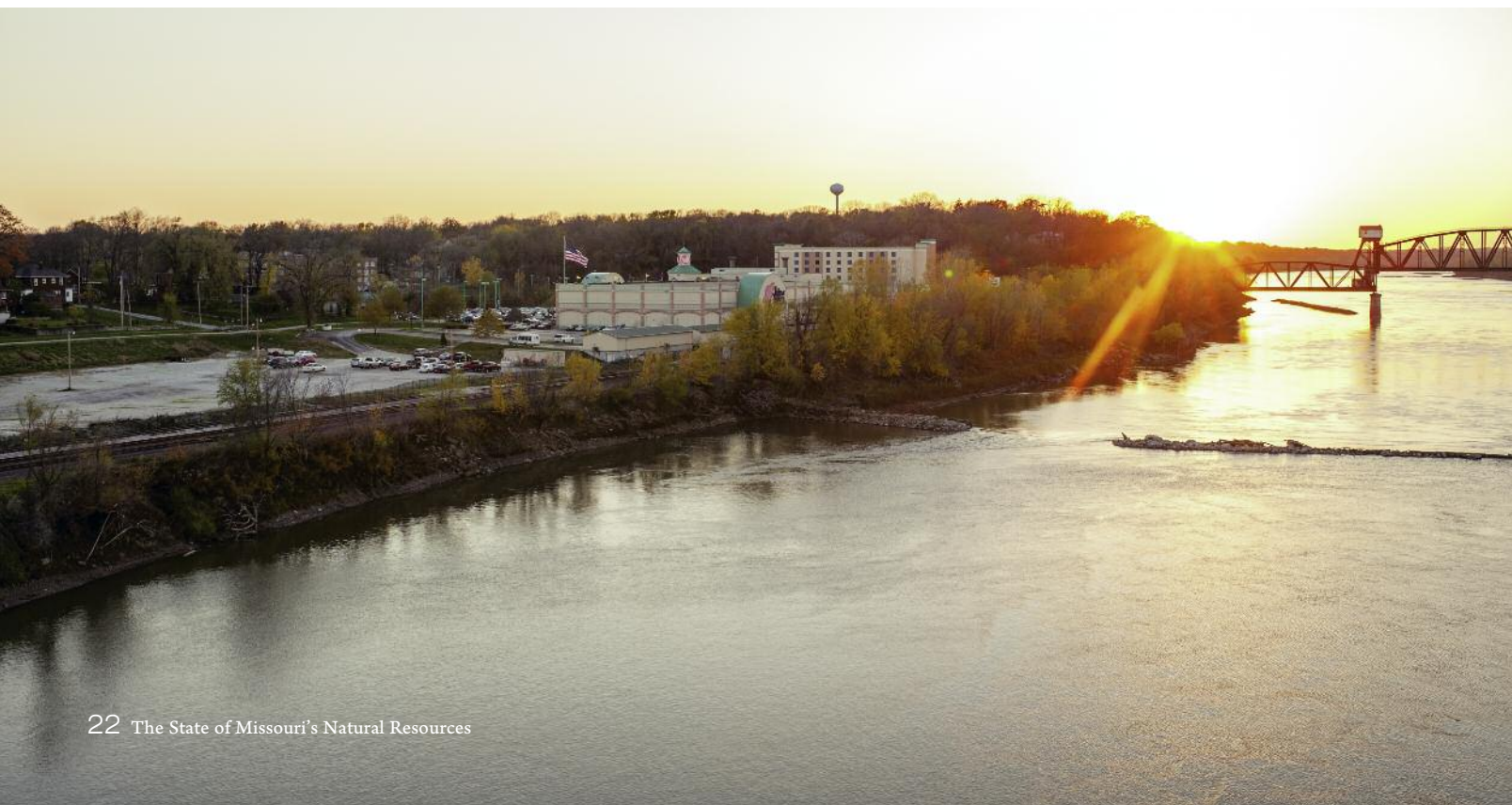
Due to declining annual revenues to the DERT fund, the department no longer accepts new applications.

After the Cleanup: Long-Term Stewardship

The department's Hazardous Waste Program provides oversight on risk-based cleanups for thousands of hazardous substance sites in Missouri, and the number increases each year. When it is too difficult or too costly to remove all the contamination from soil or groundwater, engineered or institutional controls may be used to prevent exposure to residual contamination. Engineered controls are physical measures that limit direct contact; reduce contamination levels; or control contaminant migration from a site.

Institutional controls are legal or administrative instruments, such as environmental covenants, intended to minimize the potential for human exposure to contamination by limit-

The Isle of Capri Casino in Boonville was built on 30 acres of land remediated for unrestricted use under the department's Brownfields/Voluntary Cleanup Program.



ing certain land or resource uses.

These sites require long-term stewardship plans to reliably prevent residual contamination or other environmental conditions from posing a risk to human health or the environment following the completion of cleanup, disposal or stabilization at a site.

Long-term stewardship activities at sites include inspection, maintenance of institution and engineered controls, information management and distribution, and public awareness efforts.

Natural Resource Damages

The department director serves as the trustee for natural resources in Missouri. As part of that obligation, the department has the responsibility to ensure the public is compensated or “made whole” when natural resources are injured. In the case of a hazardous substance release or other incident that injures natural resources, state and federal law allows the department to assess these injuries and seek damages from responsible parties. These activities are carried out by the department’s Natural Resource Damages and Assessment program.

Examples of natural resources that are considered part of the “public trust” include land, surface water, groundwater, plants, fish and wildlife. The program includes the technical and legal expertise necessary to assess injury to these resources, formulate damage claims and conduct appropriate restoration activities.

In a typical situation, the department prepares an estimate of the cost to restore an injured resource and calculates a damage claim. The department then negotiates with the responsible party or parties to either restore the injured resource, acquire an equivalent resource or come to agreement on a monetary settlement to resolve the damage claim.

In most cases that have been resolved to date, an assessment of injury and claim for damages has resulted in monetary settlements with responsible parties. Some of the largest settlements have been related to past mining activities. The department and its federal co-trustees work cooperatively in these assessments and settlements.

In order to use the funds from these settlements to conduct restoration, the



As of calendar year 2013, 107,547 acres have been reclaimed for productive use through the Missouri Abandoned Mine Lands Program.

department and its federal partners have developed regional restoration plans. The Springfield Plateau Regional Restoration Plan (for portions of southwest Missouri) has been finalized and two requests for proposals have been released. One proposal focuses on the restoration of mined lands in Jasper County, and the other is for the purchase of upland resources in Jasper and Newton counties. The Southeast Missouri Regional Restoration Plan was recently finalized.

Lead Mining and Lead Legacy

Missouri has a history of lead mining reaching back to the late 1700s and there still are several active lead mines operating in southeast Missouri. For

much of its history, Missouri ranked first in the world in lead production. Consequently, lead has been an important part of Missouri’s economy. The department regulates active lead mining and processing operations to limit air, water and land pollution.

Missouri’s long history of lead mining and processing has come with an environmental cost. Tens of thousands of acres of land and hundreds of miles of streams contaminated with lead and other heavy metals pose risks to human health and the ecosystem.

The Department of Natural Resources also works with federal partner agencies to address legacy contamination and return these lands to safe and ecologically sound condition for future productive use.



Run-off from former coal mining sites impairs area streams and groundwater with sedimentation and elevated acidity.

Limestone and Other Industrial Minerals

In an early journal entry, explorer William Clark described one of Missouri's most abundant natural resources – limestone. Although we may pay little attention to the limestone quarry we pass alongside the highway, we depend on products derived from that quarry in our everyday lives. These raw materials are key components in construction of roads, bridges, buildings, homes and other products that are essential to our way of life.

Development of Missouri's abundant supply of limestone is just one example of the important role geology plays in our state's economy. The department's Missouri Geological Survey produces and disseminates geologic and hydrologic information related to limestone and other important mineral resources to facilitate responsible development of these mineral resources.

There are about 35,000 acres of industrial minerals, including limestone, gravel and clay quarries. The department ensures mineral resources are extracted in an environmentally sound manner through various regulatory activities protecting air and water quality,

and reclaiming the land upon completion of mining.

Coal Mining

Imagine a land so barren and without vegetation that it has earned the nickname "moonscape." Because of past coal mining practices, this was a reality in many parts of Missouri. When acidic materials are exposed on the soil surface as a result of mining, those soils will not support a vegetative cover and have a lunar-like appearance. In the past, strip mining allowed acid mine wastes to seep into local waters, resulting in degradation of aquatic habitat and diminished water quality.

Although coal mining in Missouri has decreased in recent years, the need to reclaim any land previously disturbed by strip mining remains. Businesses and communities have worked diligently with the department to clean up these mines. In fact, more than 28,000 cumulative acres have been returned to productive use through 2013. Unfortunately, much reclamation work remains to be done with limited resources to do it.

The department received approximately \$2.7 million in federal funds last year from a federal coal tax that has

allowed continued efforts to clean up coal-mined lands affected prior to 1977. The abandoned mine land reauthorization, signed into law on Dec. 20, 2006, amended the 1977 Surface Mining Control Act. This extended Missouri's abandoned mine land program funding until 2021. Work through the abandoned mine land program and other programs in Missouri have reduced the number of stream miles impaired by acid mine drainage from about 100 miles to 11, but long-term effects most likely will remain.

Missouri has approximately 3,600 acres of coal-mined land that require monthly inspections. Missouri regulates active coal mines as well. However, because Missouri coal is high in sulfur, coal users typically find it more economical to import low-sulfur coal from the Powder River Basin in Wyoming. Consequently, the market for Missouri coal is limited and only one producing coal mine remains with six other mines in reclamation.

Interstate Mining Compact Commission

By state statute, Missouri is a member of the Interstate Mining Compact

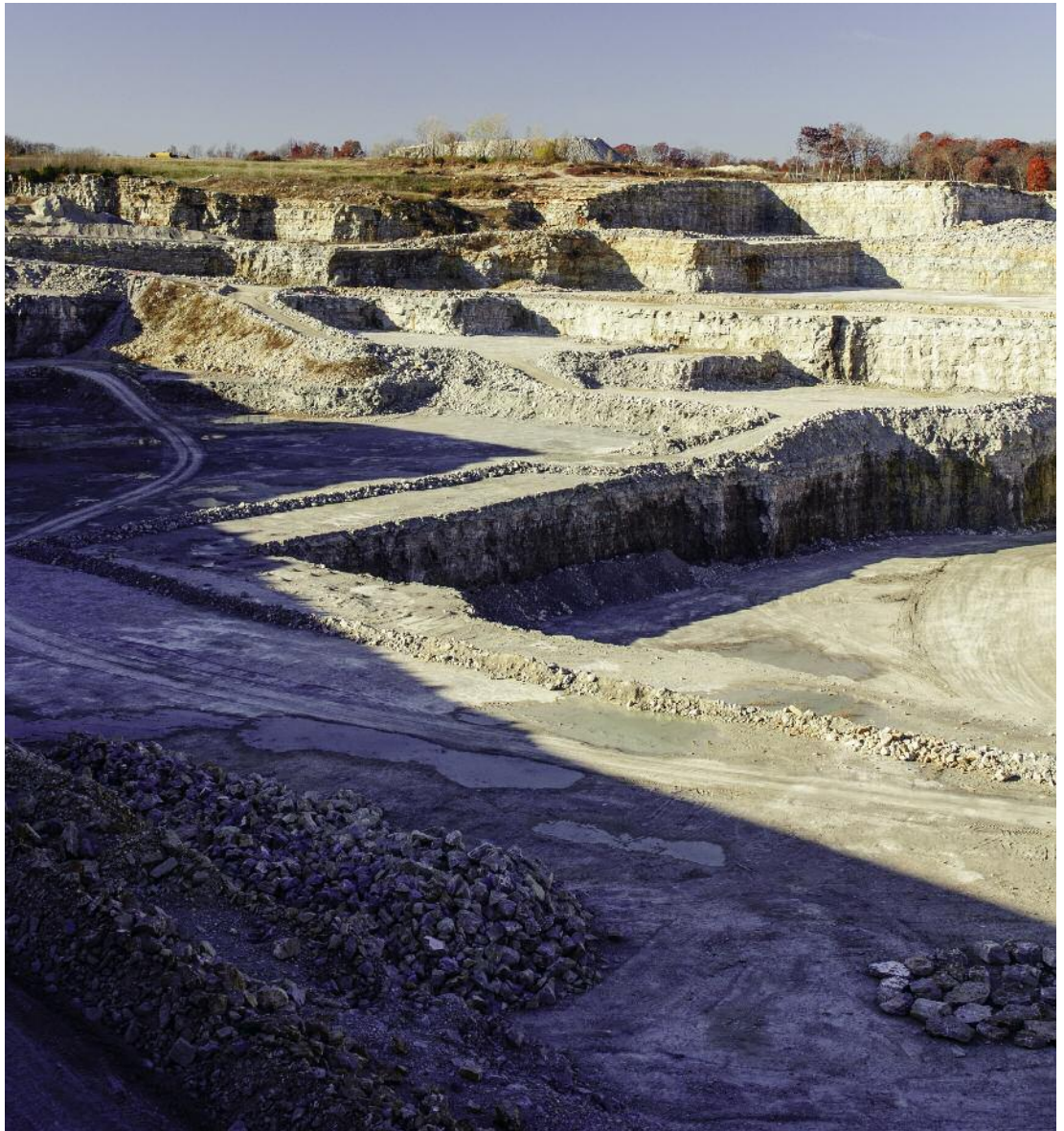
Commission. The compact is a multi-state governmental organization focusing only on mining and related environmental protection issues affecting the states, particularly with respect to the states' implementation of these types of regulatory or public policy programs.

The compact's purposes are to advance the protection and restoration of land, water and other resources affected by mining through the encouragement of programs in each of the party states.

This multi-state approach will ensure comparable results in protecting, conserving and improving the usefulness of natural resources. The cooperative effort assists in achieving and maintaining an efficient, productive and economically viable mining industry.

Participation in the compact is gained through the enactment of legislation by the states authorizing their entry into the compact.

The participating states are represented by their respective governors who serve as commissioners.



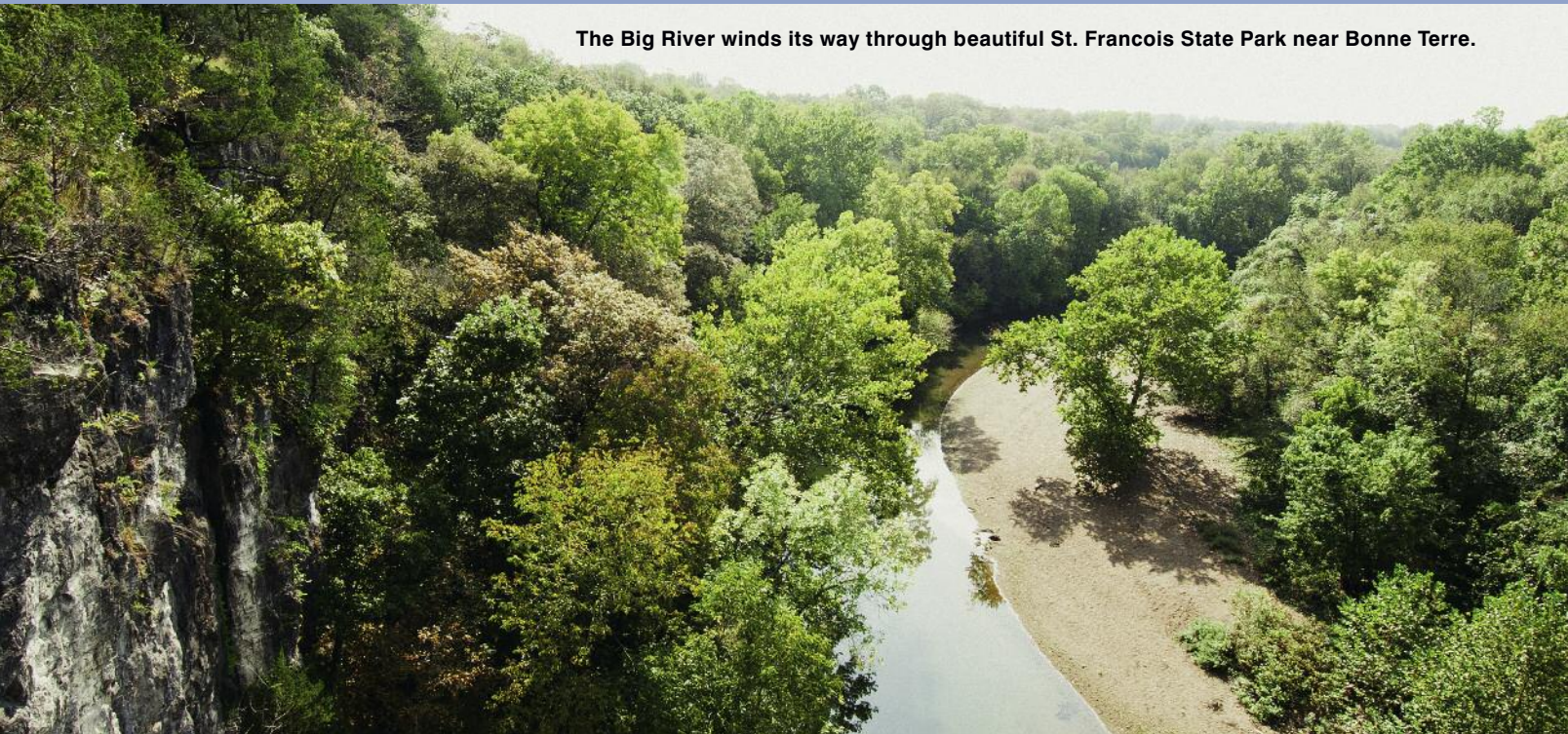
This limestone quarry in Boone County typifies the industry standards for responsible mineral extraction in Missouri mining operations. Once closed, the land will be environmentally reclaimed.

CHALLENGES: Protecting Our Land and Soil Resources

- Old abandoned landfills can pose a threat to human health, safety and the environment. Many were constructed without the use of modern day technology and design requirements. They can contaminate groundwater with leachate, contaminate adjacent surface waters with sediment, and pose a threat from migration of methane gas. The department has limited resources to address these legacy sites.
- Missouri's long history of lead mining and processing left tens of thousands of acres of land and hundreds of miles of streams contaminated with lead and other heavy metals that pose risks to human health and the ecosystem. The department continues to work with federal partner agencies to return these lands to safe and ecologically sound condition for future productive use.
- Environmental cleanups often leave some residual contamination in place. Long-term stewardship of these sites is needed to ensure that institutional and engineering controls remain in place to prevent people from coming in contact with these contaminants. The department is developing effective stewardship tools to ensure these controls continue to protect in the future.
- When soil enters Missouri's waters through natural or man-made processes, it can have a negative effect on aquatic life, drinking water and recreation. As soil is washed away from the land, pollutants such as pesticides and fertilizers are often carried with it. Some of these chemicals can remain in the water for long periods of time, and for long distances – in some cases all the way to the Gulf of Mexico. Implementing effective soil and water conservation practices reduces pollutants that enter Missouri's streams, rivers, lakes and water supply reservoirs.

Our Unique Places

The Big River winds its way through beautiful St. Francois State Park near Bonne Terre.



Missouri State Parks has consistently been ranked as one of the top four state park systems in the nation. The 87 state parks and historic sites contain more than 200,000 acres, which includes the Roger Pryor Pioneer Backcountry, available to the public. The system includes homes of famous Missourians, Civil War battlefields, and reminders of yesterday such as gristmills and covered bridges. Missouri State Parks also protects and preserves the state's most outstanding landscapes – deep forests, glades, prairies, blue streams and clear lakes – for everyone's enjoyment. In 2013, nearly 17.5 million people visited Missouri State Parks to hike, camp, fish, discover the past and simply explore nature.

Since 1917, the Missouri state park system has a proud tradition of preserving and interpreting the state's most outstanding natural landscapes and cultural landmarks while providing a variety of recreational opportunities. To accomplish this mission, the state park system preserves pieces of Missouri's history and its most outstanding natural features. Within these places are many

opportunities for recreation. In order to make the 87 state parks and historic sites in the system a great place to enjoy nature and discover the past, Missouri State Parks manages a wide variety of structures and facilities. These include 49 regulated public water systems, more than 2,000 structures, 260 miles of paved roadway, 96 wastewater systems, nearly 1,000 miles of managed trails, and 3,591 campsites.

Missourians are proud of their state parks. In 1984, they voted to support state parks and soil conservation with a 1/10th of one cent sales tax. When the Parks, Soils and Water Sales Tax was last renewed at the polls in 2006, more than 71 percent of Missourians voted to support the tax.

The Missouri state park system also has a positive economic impact on the state and local communities. Results of an economic impact study released in 2012 estimate that total annual expenditures of state park visitors in 2011 were approximately \$778 million. The overall economic impact of these expenditures is estimated at \$1.02 billion in sales, \$307 million in payroll and related

income, and \$123 million in federal, state and local taxes. Also, visitors' expenditures support 14,535 jobs. For every dollar spent by Missouri State Parks to operate the state park system, Missouri's economy saw a \$26 return on investment. These impacts show that Missouri state parks enhance our state's economy as well as improve visitor's health and well-being.

Best Trails State

In 2013, Missouri was named the "Best Trails State" by American Trails, a national, nonprofit organization working on behalf of the nation's hiking, biking and riding trails. The national award is presented every two years to the state that has made tremendous contributions to promote and improve their trail system. Missouri State Parks offers almost 1,000 miles of managed trails and the state claims more than 500 miles of National Recreation Trails designated by the U.S. Department of Interior. The state lives up to its reputation as "Gateway to the West" with significant trails including the Lewis and Clark, Trail of Tears, and Santa Fe

100 Missouri Miles Challenge Encourages Outdoor Activity

To celebrate Missouri's distinction as the "Best Trails State" and to encourage Missourians to enjoy the outdoors, Gov. Jay Nixon and first lady Georganne Nixon invited Missourians to join them in completing 100 Missouri Miles of outdoor physical activity. The program launched in June 2013 and more than 12,500 participants logged more than 1 million miles by running, walking, bicycling, paddling or rolling within the first year. In March 2014, a crowd joined the Governor and first lady at Rock Bridge Memorial State Park in Columbia to launch the second year of the Governor's 100 Missouri Miles Challenge and again encourage Missourians to enjoy healthy outdoor activity. Visit 100missourimiles.com for more information.



National Historic Trails passing through the state, and the Pony Express, California and Oregon National Historic Trails beginning on the western border. Missouri is also the home of Katy Trail State Park, the longest developed rail-to-trails in the nation.

The award also recognized Missouri State Parks for a project that began in 2008 to inventory and manage trails, which is being used in a statewide effort to consolidate and coordinate trail data. Missouri State Parks recently released *Trails of Missouri State Parks*, a book that provides detailed information on more than 230 Missouri State Parks trails. The database and resulting trail book were also recognized by the Society of Outdoor Recreation Professionals (SORP) with the 2013 Project Excellence Award. SORP presents the award annually to exemplary projects in the field of outdoor recreation research, planning, management and policy.

In 2014, *Trails of Missouri State Parks* was recognized by the Coalition for Recreational Trails with the 2014 Annual Achievement Award. The award recognized the project as an outstanding use of Recreational Trails Program funds in the category of Education and Communication. The award was accepted by U.S. Rep. Lacy Clay on behalf of Missouri State Parks at a presentation in Washington, D.C. The award in the Education and Communication category specifically honors projects that enhance trail use and enjoyment through increased environmental awareness, promotion of trail-related safety,

and encouragement of trail-related outdoor recreation.

State Park Youth Corps

In 2013, Missouri State Parks also marked the fourth successful year for State Parks Youth Corps (SPYC), a jobs program that provides Missouri youth with work experience while improving our state parks and historic sites. In 2013, SPYC hired more than 300 young Missourians to work in state parks and historic sites. The SPYC participants, ranging in age from 17-23, completed more than 70,000 hours of work in state parks and historic sites. Tasks included trail maintenance, landscaping, painting historic structures and leading interpretive programs.

The State Parks Youth Corps is a cooperative program between the Missouri departments of Natural Resources and Economic Development.

In 2013, Missouri State Parks Youth Corps was accepted as a part of the 21st Century Conservation Service Corps. The national program works to connect youth and veterans with job and training opportunities protecting, restoring and enhancing America's natural and cultural resources.

Learn2 Series

Missouri State Parks works to introduce more Missourians to our abundant natural resources. Enjoying the outdoors is the goal of the Learn2 programs offered by Missouri State Parks at sites throughout the state. For the second year, staff at participating parks offered training on camping, paddling and other

Camp Pin Oak Rises from the Ashes

On Oct. 16, Gov. Jay Nixon cut the ceremonial ribbon reopening the Camp Pin Oak Lodge at Lake of the Ozarks State Park. He was joined by students and officials from State Fair Community College, and leadership from the Missouri Department of Natural Resources. The original structure, built in the 1930s by the Civilian Conservation Corps, caught fire during a thunderstorm in 2010.

In 2011, Gov. Nixon announced a memorandum of agreement between Missouri State Parks and State Fair Community College in Sedalia for a training and education project with students rebuilding the lodge. The Missouri Department of Economic Development authorized a community development block grant of \$1.5 million to Pettis County to fund the project.

The finished Camp Pin Oak Lodge was built with careful attention to historical accuracy in the same location and approximate size of the original structure. Features were designed to match the original design. The rebuilt lodge includes a modern kitchen, laundry and accessible restrooms. The hall accommodates 135 people, is fully accessible and is centrally heated and cooled.

activities, with the programs specifically tailored for individuals and families with little or no outdoor experience.

Tents, stoves, kitchen kits, sleeping pads and other camping equipment are provided for the weekend Learn2 Camp programs through a partnership with The North Face under its "Explore Your Parks" program.

During 2013, there were Learn2 Camp programs at five state parks with 77 people participating. Sessions were taught at Robertsville, Trail of Tears, Montauk and Weston Bend state parks and Arrow Rock State Historic Site. In 2014, programs were held at Onondaga Cave, St. Francois, Weston Bend and Long Branch state parks. Learn2 Paddle

Near Rocheport, Katy Trail State Park is nestled between tall river bluffs and the Missouri River.



Mobile Tour System Available

Missouri State Parks is piloting the use of hand-held mobile devices to provide audio tours at Weston Bend State Park near Weston, and Mastodon State Historic Site in Imperial. These mobile tours, provided through the OnCell Mobile Tour System, offer visitors another avenue to learn about the cultural and natural aspects of each site through historical images, written text and audio commentary.

Once a visitor is at a participating park or site, they can access the mobile tour in a variety of ways. The full tour can be accessed through the Internet, the OnCell app, or by scanning the QR Code on each tour stop sign. The tour can also be accessed by calling the phone number listed on the tour signs. Once the number is called, the audio portion of the tour will play.



National Initiatives Provide New Opportunities

Continuing efforts to engage visitors and attract new guests, Missouri State Parks increased efforts to participate in national initiatives. These programs provide the opportunity to show support for national partners while utilizing resources offered through these programs.

- **First Day Hikes:** In January, we get the year started off right with a guided hike.
- **Kids to Parks:** In May, we encourage kids to start the summer off with family-focused activities.
- **National Trails Day:** In June, we celebrate our award-winning trail system with guided hikes and activities.
- **The Great American Backyard Campout:** In June, we bring together families, friends and youth groups with nature for a fun and memorable night sleeping under the stars.
- **National Public Lands Day:** In September, we join with our volunteers to celebrate and improve our public lands.

programs allow visitors to learn more about kayaking in Missouri State Parks. In 2013, 272 people signed up for classes in Lake Wappapello, Crowder, Cuivre River, Wakonda, Stockton and Finger Lakes state parks. In 2014, Learn2 Paddle classes will be offered at Cuivre River, Wakonda, Mark Twain, Pomme de Terre, Long Branch, Knob Noster, Stockton and Finger Lakes state parks.

Interpretation

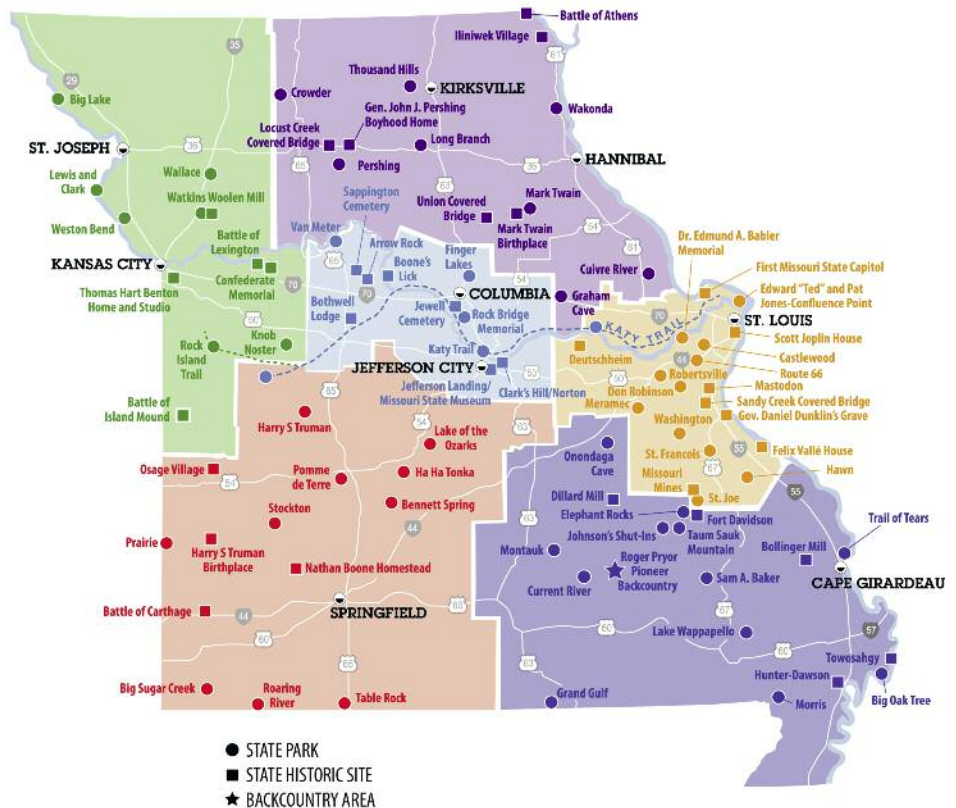
Missouri State Parks interpreters work to bring state parks and historic sites to life for visitors. In 2013, they were recognized for their world-class work at a meeting of the Association of Missouri Interpreters. The organization recognized excellence in the field. All awards were taken by Missouri State Parks interpreters and naturalists. Visitors can experience the award-winning work of Missouri State Parks interpreters by attending a program at a park or site near them.

Enhancing Missouri State Parks

Enhancing the experience for campers is also an ongoing effort. Missouri State Parks offers 40 campgrounds, and many parks have traditional cabins or camper cabins for visitors to enjoy. An additional experience is now available for park visitors to enjoy alternative lodging that is economical and comfortable.

In 2013, construction was completed on an additional yurt at Lake of the Ozarks State Park and two new yurts at Pomme de Terre State Park. Yurts are a cross between a tent and a traditional cabin or RV camper. The structure has a wood floor and is fastened to a railed deck that sits on concrete footings. The yurt has a front door that locks, and three mesh-screened windows that can seal shut with clear vinyl framed in Velcro. The yurt has electricity, air conditioning and heat, a small refrigerator

Missouri State Parks and Historic Sites



and a microwave, but does not have running water.

Missouri State Parks continues to look for new opportunities to preserve and protect Missouri's natural resources. In 2013, the state acquired 330 acres of property in Shannon County. The property, historically referred to as Camp Zoe, is located adjacent to Current River State Park and downstream from Montauk State Park. It also abuts the 60,000-acre Roger Pryor Pioneer Backcountry, which is managed by Missouri State Parks.

Originally opening in 1929 as a youth camp, Camp Zoe provided opportunities for thousands of young people to connect with the outdoors. Missouri State Parks became interested in the property for its beauty and the potential to give visitors even more opportunities

to enjoy this beautiful part of the state. Among the exceptional natural resources is Sinkin Creek near its confluence with the Current River.

The property features sheer bluffs that trace the water's edge and provide a stunning landscape. The property is also rich in bird life and vegetation, including forest and glade ecosystems. Plans for development of the property and future use of Camp Zoe are in the preliminary stages.

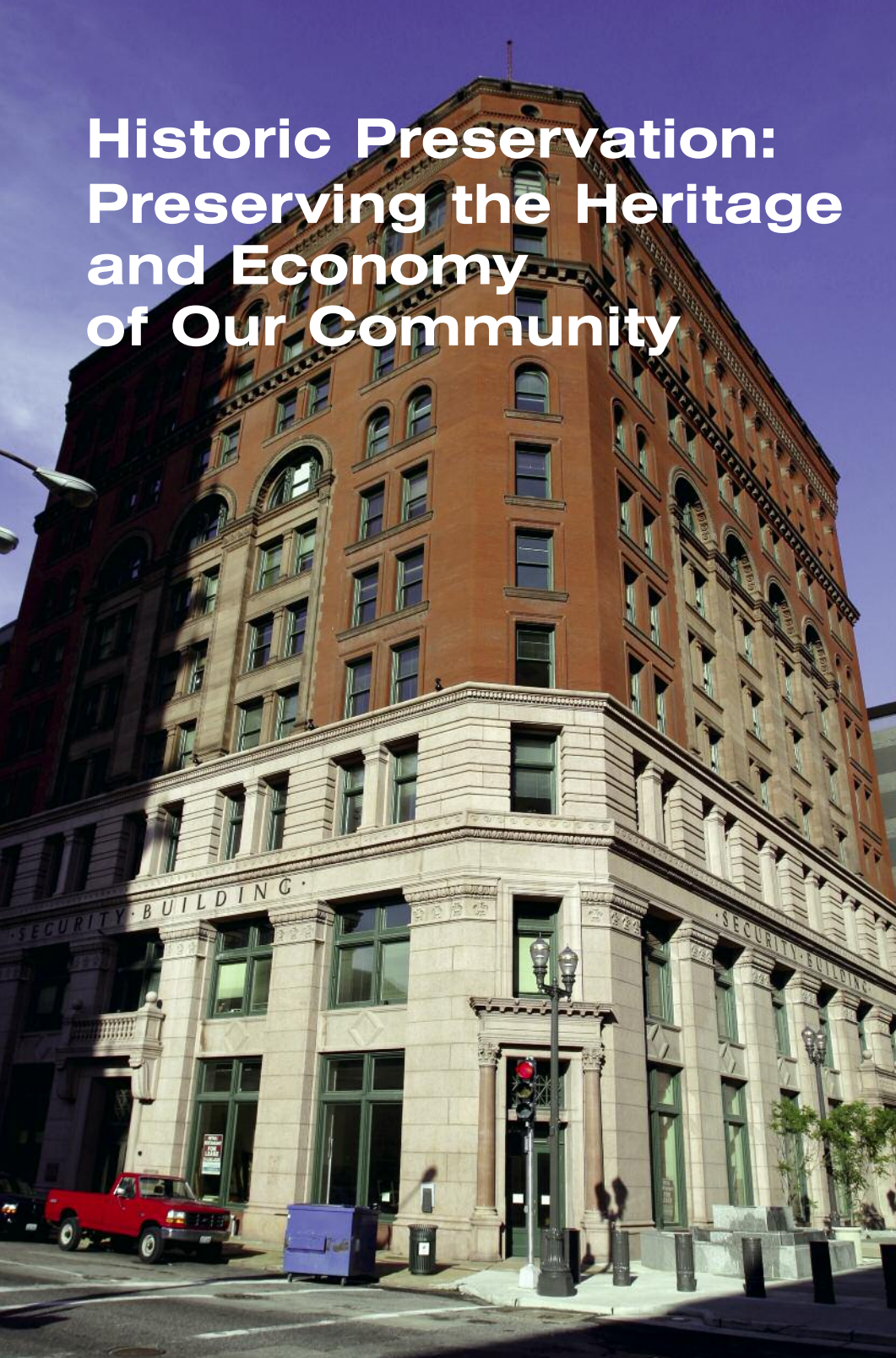
Whether through nature programs, assisting campers or teaching outdoors skills, staff do a great job making sure guests enjoy their experience in Missouri State Parks. Thanks to the team's efforts, state parks consistently earn a 97 percent approval rating.

We invite you to explore and experience nature in Missouri state parks.

CHALLENGES: Protecting Our Unique Places

- Increase visitation among all Missourians and out of state visitors.
- Work with partners and the public to help Missourians personally connect with the state's natural and cultural resources.
- Enhance and improve communication with all constituents of all backgrounds and abilities, especially youth audiences, underserved clienteles and decision-makers.
- Support recreation activities by improving facilities and infrastructure and enhancing programming beyond do-it-yourself activities.
- Secure new revenue streams and strengthen existing partnerships to support the park system.

Historic Preservation: Preserving the Heritage and Economy of Our Community



“The spirit and the direction of the Nation are founded upon and reflected in historic heritage ... the preservation of this irreplaceable heritage is in the public interest so that its vital legacy of cultural, educational, esthetic, inspirational, economic and energy benefits will be maintained and enriched for future generations of Americans.”

– National Historic Preservation Act of 1966

**The Security Building in St. Louis,
a city landmark built in 1892.**

Successful preservation of the state’s irreplaceable heritage is the result of partnerships – partnerships between federal, state and local governments, private developers, individuals and organizations with an interest and love for the historic and cultural resources that define the character of our state. The State Historic Preservation Office (SHPO) in the

Missouri Department of Natural Resources is responsible, in partnership with the U.S. Department of the Interior’s National Park Service and local governments, in carrying out the mandates of the National Historic Preservation Act (P.L. 89-665, as amended) in Missouri. The SHPO works with citizens and groups throughout the state to identify, evaluate and protect

Missouri’s significant and diverse range of historic, architectural and archaeological resources.

Appreciation of the value of historic resources is one way of fostering their preservation. The SHPO funds and coordinates surveys to identify historic, architectural and archaeological resources throughout the state. The most significant properties identified in



The Philip Hess House in Old Munichburg, Jefferson City, was built in 1860 and is on the National Register of Historic Places.

the surveys are nominated to the National Register of Historic Places, the federal list of properties deemed worthy of recognition and protection.

Information gathered in the survey and nomination process is maintained in the Missouri Cultural Resource Inventory, a continually growing database of information. Much of this information has been made available in digital format online.

The SHPO has helped foster at least one listing in the National Register of Historic Places in each of Missouri's counties and has overseen more than 2,307 listings in the National Register of Historic Places. These listings represent over 43,621 individual historic properties in the state.

Certified Local Governments are an important part of the federal-state-local preservation partnership. The SHPO assists municipal and county governments in achieving certification and provides intensive training in the preservation of local resources to local historic preservation commissions. Through the

Certified Local Government program, SHPO has developed historic preservation partnership agreements with 55 Missouri communities.

Another responsibility of the SHPO is Section 106 review of federally funded or assisted projects to ensure compliance with the National Historic Preservation Act. Staff assess the significance of properties within project areas, review the impact of the projects on significant resources and consult with agencies to develop ways to avoid or mitigate damage to the resources.

The office also works with owners, architects and developers to ensure that rehabilitation projects qualify for rehabilitation tax credits. Currently, both state and federal income tax credits are available for the qualified rehabilitation of certain historic properties. The SHPO cooperates with the National Park Service and the Missouri Department of Economic Development in reviewing applications for the federal and the state credits. Staff architects provide advice on appropriate rehabilitation treatments

and forward applications to the appropriate federal and state agencies for final approval. Since their creation in 1998, SHPO has helped review over 2,357 rehabilitation projects utilizing the Missouri Rehabilitation Tax Credits. These projects have resulted in an investment in the state's economy of \$7.1 million.

The Missouri's Heritage Properties Program is a state funded program that allows the Department of Natural Resources to help preserve historically significant buildings that currently reside in public ownership.

Since its inception, the program has targeted Missouri's historic courthouses and funded roughly a third of these important resources.

The SHPO provides training and educational services to the general public, local commissions, agencies and preservation consultants to promote awareness and understanding of historic preservation and preservation programs. Technical assistance is provided to all citizens free of charge.

CHALLENGES: Historic Preservation

- Increase awareness of the importance of Missouri's historic and cultural resources and encourage efforts aimed at fostering their appropriate preservation, rehabilitation or reuse.
- Continue our efforts to identify, evaluate, recognize and protect the historic resources within the state.
- Assist constituents and preservation partners in developing appropriate and innovative strategies to assist in the preservation of Missouri's historic and cultural heritage.

Our Water Resources

The Grand Falls on Shoal Creek in Joplin.



Clean water is a shared resource – the water quality decisions we make in Missouri can affect more than just Missouri’s quality of water and precious soil resources. Earth is a water planet, and thousands of pollution sources can impair our soil, groundwater and surface water quality. This has far-reaching consequences for all Missourians, as well as our neighbors.

There is a great deal of overlap between the risks that can threaten our land and those that pose a threat to our water. The consequences of our choices are interconnected. Across Missouri, schools, universities, businesses, local governments, elected officials, community groups and private citizens work to protect water quality and availability on several fronts. These include: preventing or controlling discharge of pollution to our rivers, lakes and streams and groundwater; reducing soil erosion; developing a state water plan to ensure adequate water resources; and engag-

ing other states and the federal government to maintain the future beneficial uses of interstate water for each and every Missouri citizen.

Water Quantity and Monitoring

Missouri is truly blessed with abundant water resources, such as large rivers, streams, lakes, and high-quality aquifers. However, the quantity of water may not always be adequate to meet demand during times of drought or when conflict arises between competing water uses. Missouri is working to improve its knowledge base regarding water supply, water use and assessment of future needs.

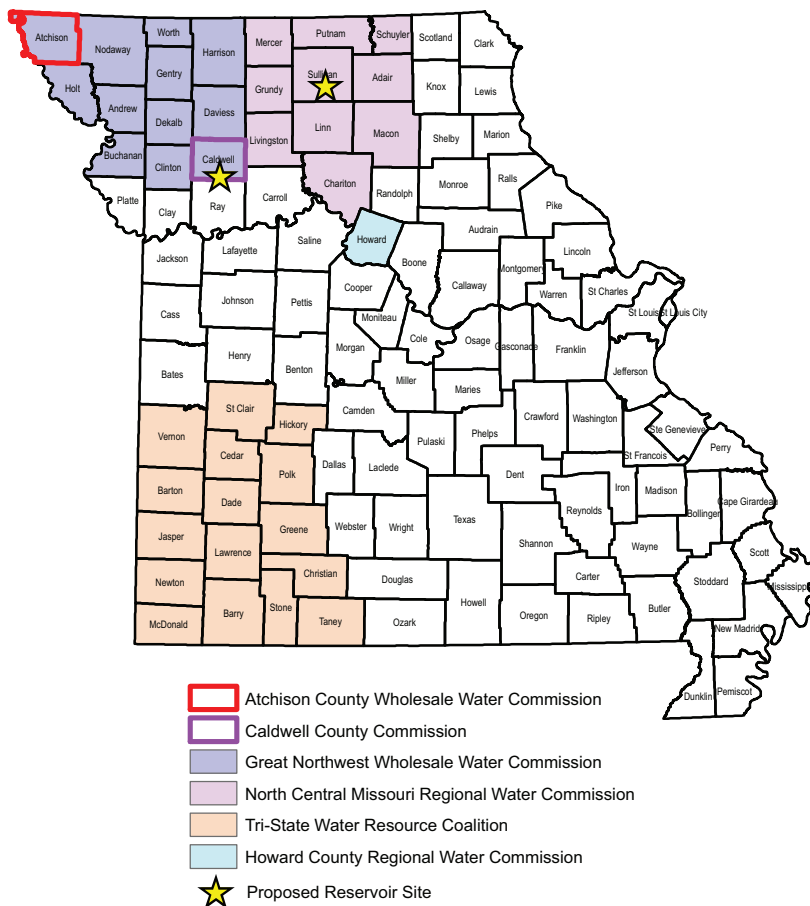
The state continues to operate, maintain, and expand its groundwater level monitoring network. A major expansion project took place in 2009 and 2012, which more than doubled the number of wells in the network. The groundwater-level monitoring network is operated

and maintained by the department’s Water Resources Center and currently consists of 164 wells, second in number nationally only to Florida’s 165 sites.

These wells monitor 12 separate Missouri aquifers statewide. Both real-time data and historic data, dating back to the 1950s, collected by the network is served to the public online. The department added two wells in 2013 and plans to add an additional five wells in 2014, bringing the total number of groundwater level monitoring wells to 169. Many wells are located in areas of high groundwater use to monitor potential impacts to water levels from extensive pumping. In addition, there are several wells located in areas of low groundwater use to illustrate potential fluctuations in groundwater levels due to climatological variations.

The department also helps to provide real-time river and stream flow information by funding more than 50 stream gages in Missouri. Automated

Regional Water Supply Development Projects



parts of Missouri. The Great Northwest Wholesale Water Commission continues to develop plans and cost estimates for a regional water transmission pipeline network that will move water from reliable sources to areas of need. In north central Missouri, the Caldwell County Commission has acquired property and permitting is under way for a drinking water supply reservoir that will serve nearly 9,500 citizens.

Similarly, the North Central Missouri Regional Water Commission is acquiring land for a 2,300-acre drinking water supply reservoir capable of providing 7 million gallons of water per day to serve a 10-county region. In southwest Missouri, the department has partnered with the Tri State Water Resource Coalition and US Army Corps of Engineers to evaluate the regional water demand. Results suggest regional water demand will increase by 125 million gallons per day, or 37 percent, by the year 2060. In addition, water supply studies have been completed for more than 40 lakes and reservoirs in the state. These studies help determine the capability of the systems to deliver water to their customers, especially during extended periods of drought.

The studies also contain a lake survey used to determine reservoir volume and rates of sedimentation or infilling.

gauges measure the water level in streams and reservoirs. Stream flow information is useful for flood forecasting, drought assessment, water quality monitoring, infrastructure design, evaluating fish and wildlife needs and recreational purposes. Stream gages are operated by the U.S. Geological survey at more than 240 locations in Missouri.

Regional Water Supply Planning

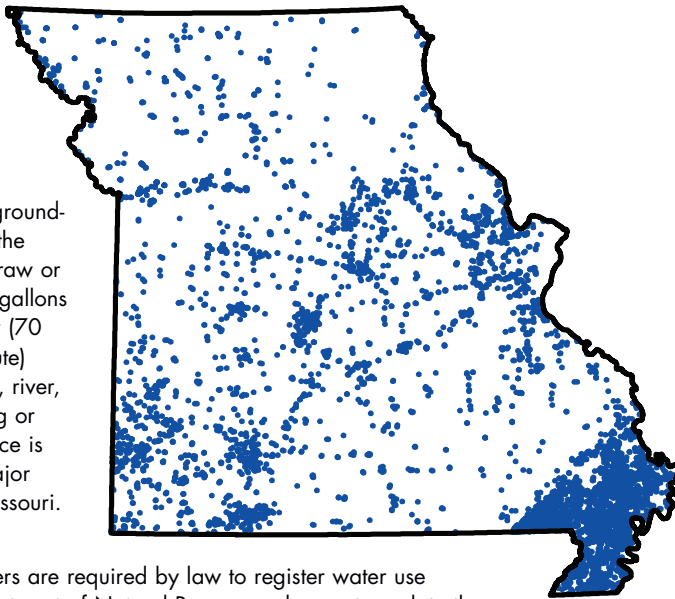
Efforts to develop reliable, long-term water supplies are ongoing in many



The Columbia public drinking water plant resides in the Missouri River bottoms of McBaine.

Water Use Reporting

Any surface or ground-water user with the capability withdraw or divert 100,000 gallons or more per day (70 gallons per minute) from any stream, river, lake, well, spring or other water source is considered a major water user in Missouri.



All major water users are required by law to register water use annually. The Department of Natural Resources does not regulate the use of water – only the amount of water a major water user has the potential to use.

Water Use Reporting

Complete and accurate accounting of water use is a major step toward developing a meaningful assessment of Missouri's current and future water needs. Water use data is currently collected and analyzed by the Missouri

Department of Natural Resources' Water Resources Center (WRC).

State law requires any entity with the capability to pump 100,000 gallons per day or more from any water source, to register with the department and report their water use annually.

In 2012, there were 2,331 registered major water users in Missouri. Of these, 1,244 submitted a water use report for 2012. These users included 375 irrigators, 621 municipal users, 97 industrial or commercial facilities, with the remaining 125 as electrical generators, livestock watering, recreation uses and mine dewatering. While reporting has increased in recent years, compliance with the Major Water User Law has been low, averaging only 60 percent.

In 2012, the compliance rate was 53 percent (1,244 out of 2,331 users submitting reports). WRC estimates the 2,331 registered major water users in 2012 represents only a portion of total major water users statewide.

Water use registration can be completed online, by email, fax or U.S. mail. There is no fee for reporting. To report water use or obtain forms online, visit the Water Resources Center's Web site at dnr.mo.gov/env/wrc/mwu-forms.htm.

Dam Safety and Emergency Action Planning

Dams and reservoirs play an important part in enhancing the quality of life in Missouri and often serve multiple functions for communities such as flood protection, water supply, irrigation, ero-



Mark Twain Lake at Mark Twain State Park, Monroe County.

Real-Time Water Level and Flow in Missouri's Waters Available Online

Each year, thousands of anglers come to fish for trout at Missouri's Bennett Spring State Park, Montauk State Park, and Roaring River State Park. People interested in the stream conditions can now take advantage of a real-time online reporting system that shows water levels and stream flow in these state parks.

The department's Water Resources Center partners with the U.S. Geological Survey (USGS) to operate a series of stream gages that measure stream conditions. USGS maintains over 240 stream gages across Missouri.

The River and Lake Level Observations, Forecasts and Precipitation Web page at dnr.mo.gov/env/wrc/currentriverobservations.htm contains a map and link to the USGS stream flow map of Missouri that shows all the stream gages located in the state. Using a computer mouse to roll over the dots on the map launches a pop-up window showing a summary of the current water conditions for that area.

For this example, we rolled over the dot showing Bennett Spring State Park. The pop-up window shows the latest readings taken within that hour, such as water stage, rate of discharge and more. By clicking the dot, another window opens on the page with links to the U.S. Geological Survey's WaterWatch Web pages. That pop-up window contains tabs with links to additional water resource conditions.

Clicking on the hydrograph tab opens a small graph showing the median discharge at the park currently and during the previous seven days. Clicking on the map opens a WaterWatch page that includes the discharge map and another map showing the latest eight days reading for gage height in feet (this is river stage).

Other tabs include peak, forecast and rating:

- **The peak tab** shows a graph featuring the current water stage, the most recent maximum stage, and the highest recorded peaks. Each of these stages include the dates those water levels were recorded. This chart contains information useful for flood tracking.
- **The forecast tab** contains a map and link to the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service map. On this page, you can navigate to Missouri maps and graphs showing the most recent and maximum stages. There is also a link to show what areas, if any, are in flood stage.
- **The rating tab** shows Stage-discharge relations (ratings) usually developed from a graphical analysis of current-meter discharge measurements (sometimes called calibrations) made over a range of stages and discharges. Each measurement is carefully made, and undergoes quality assurance review. Frequently, measurements indicate a change in the rating, often due to a change in the streambed or riparian vegetation. Such changes are called shifts; they may indicate a short- or long-term change in the rating for the gage.

People interested in the water resource conditions can use these real-time readings to determine if water conditions are favorable for fishing, canoeing or other recreational opportunities that day. Maybe you think it is better to fish in clear water and use your polarized sunglasses to see the fish approach the lure or you might think fish bite better in murky water stirred up by rainfall. In either case, you can find out the water conditions during the last eight days by looking at these charts. It's an easy way to use science to make your judgment call on when it is a prime time to fish those waters.

In addition, the three state park gauges collect flow measurements from the large springs that feed these recreational streams. This information provides hydrologists with a better understanding of how spring flow responds during precipitation events. Agencies such as the National Weather Service rely heavily on stream gauge information to issue flood watches, warnings and forecasts for major rivers and streams. River forecasters combine river stage information with the amount of anticipated rain to model how quickly and when rivers will rise and fall. Stream gauges are then used to verify the actual river stages so future flood forecasts can be prepared and issued.

The U.S. Army Corps of Engineers relies on stream gauge information to operate and manage large reservoirs such as Table Rock Lake.

During flooding, water is either held back or released from the reservoirs based on stream flow targets at specific downstream locations. During the past two years water has been stored within Table Rock Lake to prevent additional flooding in areas of Arkansas that were already experiencing high water conditions.

Stream flow information is equally important during periods of drought. During extremely low flow conditions, aquatic life in streams becomes stressed and may eventually perish. It can also be an indication that a less-than-normal amount of water is flowing in nearby streams that do not contain stream gauges. Experiencing less-than-normal flow can create problems in managing water supply reservoirs as water is withdrawn for use faster than it is being naturally replenished.

Under these conditions the lake will eventually become depleted of accessible water. With stream flow and other information, water supply reservoirs can be analyzed to estimate how long a reservoir can supply water during low flow conditions. Stream gauges collect information useful for many purposes, including the enhancement of your recreational experience. Be sure to view the available stream flow information online before the next visit to your favorite stream.

While you are on the stream, make note of conditions such as water color and clarity, ease of wading or frequency of canoe portage. Over time you can build a record of how the various river stages and flow conditions affect your recreational use and experience. You can also watch how river stage and flows change during each season and as a result of rainfall events. Before long you may even consider yourself to be a recreational hydrologist.

sion control and recreation. For these reasons, many of the reservoirs in Missouri are located in or adjacent to populated areas where they can provide citizens with a number of the benefits mentioned earlier.

The Missouri Department of Natural Resources recognizes these needs and is committed to helping ensure the integrity of these structures and the safety of nearby residents. For this reason, the department's Water Resources Center is leading an effort to develop emergency action plans for all regulated high hazard potential dams in Missouri by 2014. To date, more than 200 plans have been completed.

Approximately 470 of the 681 regulated dams in Missouri are classified as high hazard potential dams. These dams receive this designation due to the potential for significant loss of life and/or property and infrastructure damage if the dam were to fail and release a flood wave downstream.

An emergency action plan is a written plan that provides guidance for evaluation of potential dam safety emergencies, emergency response activities and potential evacuation of downstream dwellings and facilities. The plans contain critical information such as emergency call lists and notification procedures, lists of downstream residents, structures and infrastructure, a flood inundation map, and a list of available resources that can be drawn upon during an emergency.

Missouri River

The Missouri River provides nearly half of the state's drinking water, while also providing cooling water to produce

electricity, shipment of goods, recreation and tourism. The U.S. Army Corps of Engineers operates the six Missouri River Mainstem Reservoirs located in the Dakotas and Montana. From the record high in 2011, the reservoirs have steadily dropped to almost 5 million acre-feet of additional flood storage going into the 2014 runoff season.

Depletion of water remains an issue on the Missouri River from both growing use within the basin and potential out of basin transfers. The U.S. Geological Survey estimated the amount of water in the Missouri River has already been depleted by approximately 28 percent.

The majority of the water is consumed by western states, located upstream of Missouri. Rapid expansion of hydrofracking in western North Dakota has played a role in the Corps embarking on a first-ever allocation of municipal and industrial water supply from the reservoir system. After an allocation is set, downstream water supply needs would only be met after the upstream amount has been met.

The department continues to oppose out of basin depletions that would impact Missouri. One such project is the Red River Valley Water Supply Project that would divert Missouri River water to the Red River near Fargo, ND. That water would then flow into Canada and ultimately Hudson Bay. This project was originally intended to be a Bureau of Reclamation project, but has languished since 2007. North Dakota is evaluating alternatives to pursue the project with no federal financial support.

Another potential diversion being closely monitored is the Kansas

Aqueduct Project. Western Kansas Groundwater Management District 3 (GMD3) has asked the U.S. Army Corps of Engineers to update a 1982 study to divert water from the Missouri River to western Kansas to maintain the high demand for water supply, mainly for irrigational use.

This proposal would divert flows in excess of full-service navigation flows at Kansas City (flows greater than 41,000 cfs) and could take as much as 4 million acre-feet of water per year out of the basin. The Kansas Water Office also supports updating the study, which should be completed in mid-2015.

The Department of Natural Resources was appointed by the governor to represent Missouri on the Missouri River Recovery Implementation Committee (MRRIC). Authorized by the 2007 Water Resources Development Act, the committee advises the corps on actions and policy as they relate to the Missouri River Recovery Program.

The corps created the program in order to consolidate environmental restoration programs. Through the MRRIC, species recovery actions, such as the Gavins Point spring rise, are being scrutinized by an Independent Science Advisory Panel. The panel determined the spring rise included in the 2006 Master Manual did not meet the objectives as set forth in the 2003 Amended Biological Opinion. Therefore, the corps has now undertaken a review of the species needs and will be soliciting input from the MRRIC and the public through an environmental impact statement process so actions can be taken to recover the interior least tern, piping plover and pallid sturgeon.

Early morning fog rises on the Missouri River at Cooper's Landing in Boone County.



Drinking Water

About 89 percent of Missourians are served by public water systems. The other 11 percent use domestic or multi-family wells. In 2013, 94.8 percent of community populations met health-based standards. The public water systems that violate health-based standards typically are non-community or small community water systems and serve a small percentage of Missouri's population. The department focuses efforts on these smaller systems to ensure all Missouri citizens drink water that is safe.

Missouri's overall high compliance rate can largely be attributed to our good quality groundwater. Missouri does not have some of the naturally occurring contaminants like arsenic that pose challenges in other states. Most of our water is not naturally corrosive so problems related to high lead and copper levels, which can leach from pipes, have not been a major problem. Nitrates and pesticides, a major problem in several adjoining states, are very rarely found in the deep groundwater used by our public water systems.

Our large rivers and a number of reservoirs are the resources that serve our major population centers and they have comprehensive water treatment plants in place to ensure safe, plentiful water is produced.

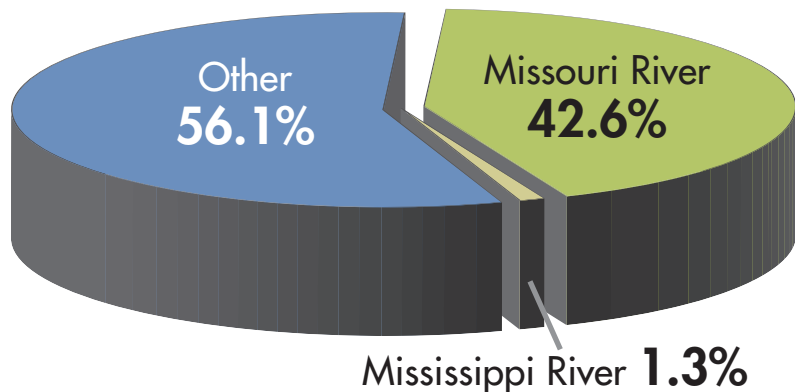
Drinking Water Source Protection

Protecting groundwater, streams, rivers, springs and lakes in a watershed is an important part of providing safe drinking water. Missouri is enhancing its emphasis on source water protection by providing funds to communities and public water systems to develop local voluntary source water protection programs and to plug abandoned wells that may provide a conduit for contamination of groundwater reservoirs. Any community public water system in Missouri is eligible to apply for Source Water Protection Project grant funding to develop a preliminary protection program or to implement protective measures and strategies identified in an existing plan.

The department also produces *The Source Protector*, a source water protection newsletter to provide information about source water protection, financial assistance programs and other

Missouri's Drinking Water Sources

For Populations Served by Community Water Systems



resources that can help communities protect their drinking water sources. The department's source water protection program collaborates closely with the department's Our Missouri Waters efforts to tie source water protection activities to other watershed based protection and preservation activities.

Source water protection activities, which typically occur on a local community level, provide an ideal foundation upon which communities can implement protective strategies. Communities engaged in local source water protection activities are in an excellent position to extend protection strategies to a regional level within any given watershed.

Drinking Water Infrastructure

Aging infrastructure continues to pose significant challenges to maintaining safe drinking water in Missouri. Failing pipes compromise drinking water quality by allowing contaminants to enter the system, potentially posing a serious health threat. This need can be addressed through inspections to identify leaks and other problems; engineering evaluations that identify current and future needs and potential solutions; asset management plans; and funding for infrastructure improvements.

Water storage tanks also present a significant challenge. Tanks are vulnerable to a host of problems, including poorly designed or defective vents, screens, hatches, overflow pipes and

other issues. Also, tanks must be properly maintained to prevent corrosion and damage from ice buildup, painting contractors, telecommunication (cell phone) antennae and other factors that can create sanitary defects allowing for contaminants to enter the tank. The department recommends that all water tanks be professionally inspected and cleaned at least every five years.

Groundwater

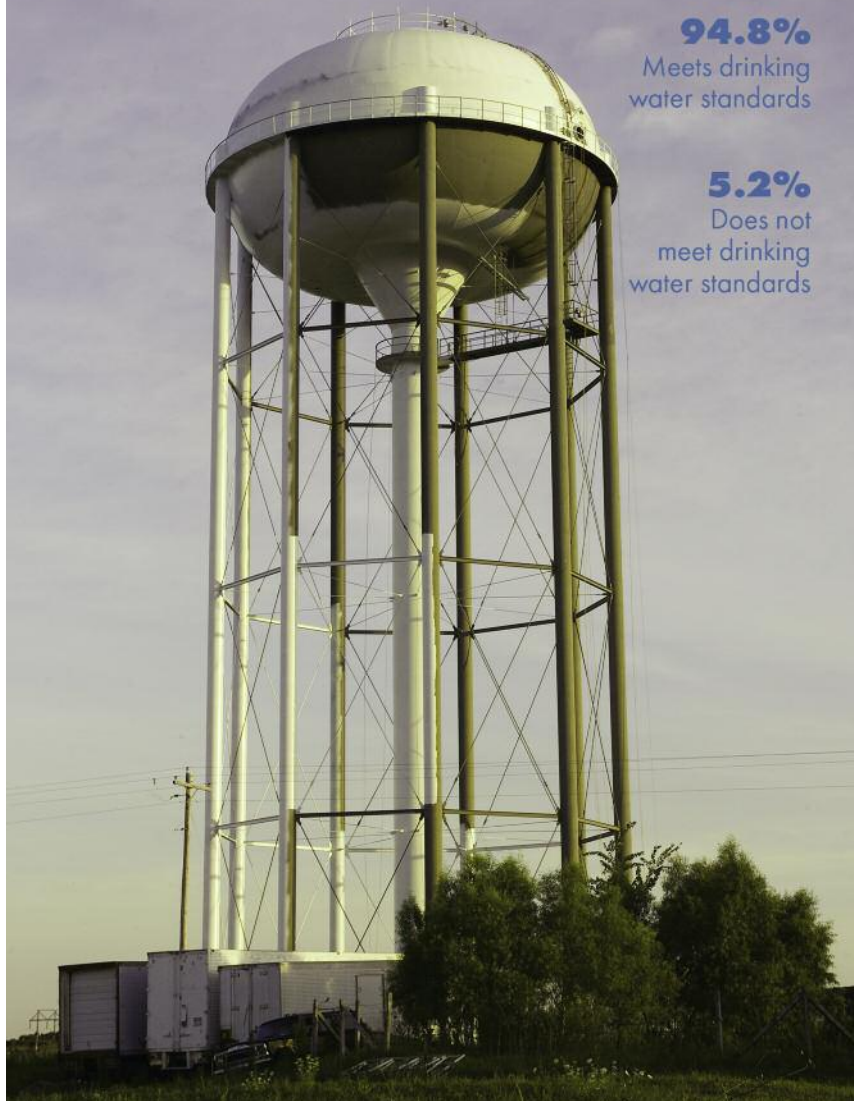
Groundwater is one of Missouri's most important natural resources. About 37 percent of Missouri's population relies on groundwater as their source of drinking water. Most public drinking water supply wells and many private wells are deep, properly cased and properly grouted. Some older, inferior quality private wells are shallow, not properly cased, nor properly grouted. More than 6,500 new water wells are drilled each year in Missouri; however, the department estimates that less than 80 percent of these wells are properly certified, and more than 300,000 abandoned wells remain unplugged. Nearby septic tanks, improperly managed feedlots or even chemical handling sites located near improperly cased wells can easily contaminate them. By properly constructing and maintaining wells and encouraging aquifer protection, we ensure safe drinking water for future generations and protect groundwater.

Missouri's aquifers contain an estimated 500 trillion gallons of fresh water. Despite this tremendous resource,

Percent of Drinking Water Meeting Health-based Standards

94.8%
Meets drinking
water standards

5.2%
Does not
meet drinking
water standards



Consolidated Water Supply District No. 1, Boone County.

groundwater overuse in some areas has caused groundwater levels locally to decline tremendously. For example, the levels in Noel, located in McDonald County, have dropped as much as 400 feet in the past 40 years. Parts of Springfield and the Joplin/Webb City/Carthage areas experience seasonal problems, as well. Prolonged drought conditions have contributed to lower groundwater levels in several regions.

Fortunately, most areas have experienced much less groundwa-

ter-level change. In the past, chemical wastes and other contaminants dumped at factories and other facilities have threatened groundwater. The department aggressively investigates groundwater contamination at these sites and pursues environmental cleanups, if necessary.

The Missouri Risk-Based Corrective Action process (see page 21) is used to provide a consistent and reasonable approach for managing site risks. However, it often is impossible to remove all contami-

nants at these sites. The Department of Natural Resources' long-term stewardship efforts are very important in such situations.

Radionuclides

Community water systems are required to test for radionuclides. A running annual average of quarterly samples is used to determine system compliance. The most common sources of radionuclides in groundwater are naturally occurring radioactive minerals in subsurface rock formations, generally due to uranium and radium deposits. Water from wells drilled into such rock formations may contain radionuclides, which dissolve in water.

Radionuclides do exist in groundwater in certain areas in Missouri. In some areas they exceed drinking water standards for radioactivity. Radionuclides in public water systems are a health concern. Some people who drink water containing radionuclides in excess of the standard over many years may have an increased cancer risk.

In an effort to protect public health, the water systems are required to test the water at the point where it enters the distribution system. The most recent department data shows that only 0.9 percent of Missouri's community water systems are currently exceeding standards for gross alpha or combined radium isotopes.

The department is working with these local water systems to bring them back into compliance. Reduced monitoring is allowed for systems with very low contaminant levels.

Protecting Our Rivers, Lakes, Streams and Groundwater

Missouri's plentiful streams, rivers, lakes and groundwater are critically important natural resources. The department's Water Protection Program is responsible for protecting and improving water quality and ensuring compliance with the federal Clean Water Act by implementing the Missouri Clean Water Law.

Some of the key activities the department carries out to protect and improve water quality include developing water quality standards, issuing permits, conducting inspections and enforcement actions, monitoring water quality, developing plans to improve water quality and providing funding to communities to upgrade their infrastructure. Some of these activities are highlighted in the following text.

Water Quality Standards

Water Quality Standards help define water quality goals and have three main components: beneficial uses, water quality criteria, and "anti-degradation" provisions. All waters in Missouri have a defined beneficial use.

Examples of beneficial uses include recre-

ation (e.g., swimming and boating), aquatic life protection, drinking water and human fish consumption.

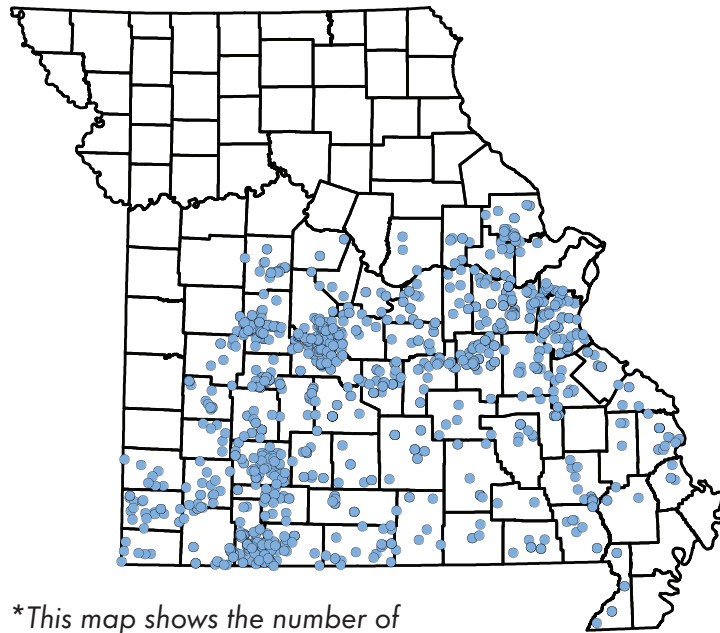
Water quality criteria are narrative or numeric expectations for waters, based on their uses. These set permit limits at levels necessary to protect the designated beneficial uses. Currently, Missouri has water quality criteria for more than 100 individual contaminants.

The purposes of the antidegradation provisions are to protect and maintain the quality of state waters including their existing and designated uses by reviewing proposed activities that might increase pollutant loads, degrade the quality, or otherwise adversely affect the uses of waters. The department's "anti-degradation procedure" establishes a clear method for identifying the appropriate levels of protection for each water and for translating that level of protection to the selection of treatment technology.

In 2013, the Clean Water Commission adopted revised water quality standards increasing protections for streams, rivers, lakes and reservoirs by assigning beneficial uses to about 80,000 additional stream miles. It also recently promulgated tiered aquatic life uses that describe the aquatic communities present in Missouri's small streams. These uses are dependent on the level of the aquatic life found in a stream. The department then can develop criteria to protect those communities. Over the next five years, the department plans to evaluate all of the state's waters to ensure those streams fully support aquatic life and are assigned use criteria that will protect them.

The federal Clean Water Act requires the department to review its water quality standards at least every three years and revise them as necessary to make them equivalent to federal standards, as judged by the U.S. Environmental Protection Agency. This process is currently under way. One of the key topics under discussion includes nutrient criteria for lakes and reservoirs. Nutrient criteria can include nitrogen, phosphorus and chlorophyll. Nutrient pollution can come from wastewater treatment plants or stormwater runoff. Excess nutrients can cause algal blooms, resulting in decreased water clarity and oxygen levels, or other negative impacts. Nutrient criteria are developed to protect beneficial uses of aquatic life protection, recreation and drinking water supply.

Public Water Systems Serving Untreated Drinking Water

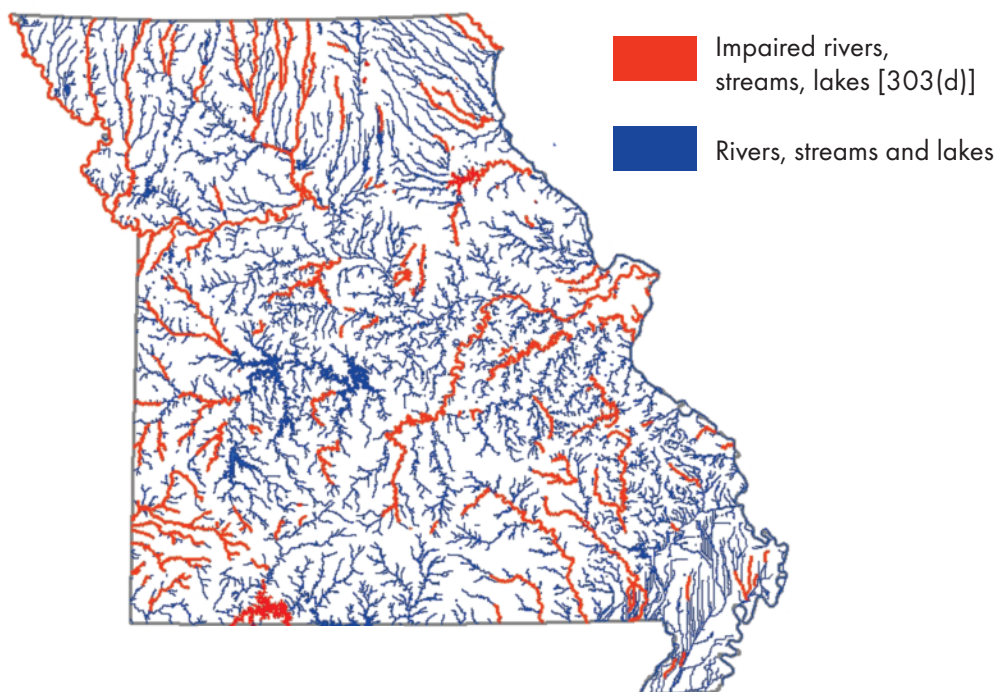


**This map shows the number of communities in Missouri where treatment of drinking water is not needed, thanks to the excellent quality of area groundwater.*



Rain barrels minimize residential runoff and help conserve water resources for plants and gardens.

Waters on Missouri's 303(d) List



Waters that do not meet the water quality standards are placed on a special list called the 303(d) List. A stream is considered impaired when it fails to meet the water quality standards set by the Missouri Clean Water Commission. Section 303(d) of the federal Clean Water Act requires states to identify and list all impaired waters. The list is revised and updated approximately every two years. The most recent list is the 2014 303(d) List, which was approved by EPA on Sept. 3, 2014.

Water Monitoring

The department, along with several partnering agencies and the University of Missouri, collects water quality data on streams, rivers and lakes across the state. The state's monitoring primarily focuses on the most obvious pollution sources, such as areas of historic pollution from old mining areas and abandoned ore smelters, agricultural runoff, including sediments, agricultural pesticides and nutrients, as well as other stormwater and major wastewater treatment discharges.

The department's water monitoring activities are greatly enhanced by the Volunteer Water Quality Monitoring program. This program is a partnership between the departments of Natural Resources and Conservation, Conservation Federation of Missouri and the citizens of Missouri. The program trains volunteers to monitor streams in their area. Information submitted by volunteers is entered into the volunteer monitoring database. Every two years, data are extracted from the volunteer database and reviewed to determine if the data indi-

cate water quality problems. Areas where volunteer data indicate potential water quality problems are targeted as high priority sites for more intensive monitoring by the Department of Natural Resources.

Additional water quality monitoring is needed to increase protection of smaller, headwater streams that support aquatic life and recreational uses. Water quality monitoring can also address emerging issues such as the effects of pharmaceuticals and other complex chemicals, and examine trends in water quality where protection efforts may be needed to avoid future water quality problems. Missouri would benefit from additional water quality monitoring to assess and confirm the effectiveness of the national criteria in protecting beneficial uses in Missouri. Additional monitoring would specifically address pathogens (bacteria), dissolved oxygen and certain pesticides and metals.

Water Quality Assessment

Water monitoring data is used to determine which waters are meeting water quali-

ty standards. Waters are considered "impaired" if they fail to meet the water quality standards. The federal Clean Water Act requires states to list all impaired waters and the pollutants causing the impairments every two years.

Once waters are listed on the impaired waters list, it triggers the requirement for an analysis of the causes of the impairment and a plan to correct it. This analysis and plan are collectively contained in a document known as a Total Maximum Daily Load, or TMDL. The TMDL establishes pollutant allocations and loading targets for "point" source and "nonpoint" sources of pollution. Point sources are wastewater discharges from pipes or other conveyances and include such things as industrial and sewage treatment plants. In contrast, nonpoint source pollution comes from many diffuse sources and is caused by rainfall or snowmelt running over the ground and picking up contaminants that then flow into the area's waterways.

The department uses the TMDL to craft appropriate pollutant limits in permits for point source discharges and to identify strategies to reduce nonpoint source pollution. TMDLs are also used by citizen watershed groups to draft restoration plans, which implement management practices to reduce nonpoint source pollution.

Restoring and Protecting Our Water Quality

The department uses a variety of strategies to reduce pollution and protect and improve water quality. These include: conducting studies to determine the pollutant levels in a watershed; issuing permits to point sources dischargers; conducting inspections of permit holders and helping violators return to compliance; developing and implementing TMDLs; providing funding to



Groundwater monitoring wells, like this one at Eagle Bluffs Conservation Area in Boone County, monitor and report aquifer levels in real-time, and are available online.

implement projects to reduce nonpoint source pollution; and providing financial assistance to communities to upgrade their local wastewater treatment infrastructure.

The development and implementation of nutrient criteria will result in new challenges for Missouri. Because nutrient pollution involves point and non-point sources, the department is considering developing limits on a watershed basis and creating a system to allow trading of pollutant reduction

“credits” between dischargers. Trading programs allow facilities facing higher pollution control costs to meet their regulatory obligations by purchasing environmentally equivalent (or superior) pollution reductions from another source at lower cost, thus achieving the same water quality improvement at lower overall cost.

Challenges to implementing a trading program involve developing appropriate ratios between sources and ensuring that once a trade occurs, the

corresponding pollutant reductions are implemented and maintained within an appropriate time frame.

Another focus area is the elimination of sanitary sewer and combined sewer overflows. Sanitary sewer overflows occur in sewer systems that were designed to carry wastewater only, and are not functioning properly. Examples of problems that cause sanitary sewer overflows include water infiltration from leaking pipes overloading the system, temporary sewer blockages, breakage, or pump failures.

These can lead to a sewer overflow, allowing untreated sewage to escape the sewer system and run directly into waterways or onto the ground, where the untreated sewage might pose a threat to public health.

Combined sewer systems are sewers that were built to collect rainwater runoff, domestic sewage and industrial wastewater in the same pipe. It is no longer legal to design a sewer system in this way, but there are many such systems across the country and five in Missouri that were constructed long before they were prohibited.

Most of the time combined sewer systems transport all of the wastewater to a sewage treatment plant, where the effluent is treated and then discarded to a relatively large body of water. However, during periods of heavy rainfall or snowmelt, the wastewater volume in a combined sewer system can exceed the capacity of the sewer system or treatment plant. For this reason, combined sewer systems are designed to overflow occasionally and discharge excess wastewater, including rainwater runoff, domestic sewage and industrial wastewater, directly to nearby streams, rivers or other bodies of waters. These periodic events are referred to as combined sewer overflows.

The department is working with EPA to help communities address their sanitary and combined sewer overflows and bring their wastewater treatment systems into compliance with the federal Clean Water Act and Missouri Clean Water Law. Developing a joint strategy helps ensure consistency and quicker resolution of the problem. This strategy includes discussions with each community to develop a plan and timeline for correcting the deficiencies, while taking into consideration any resulting financial challenges that it may create.

Financing Wastewater Infrastructure

One of the biggest obstacles to clean rivers and streams in Missouri is the cost to maintain and improve wastewater collection and treatment systems. The demand on public infrastructure has continued to grow, while financial resources have not kept pace. Missouri estimates the infrastructure needs to ensure clean water to be more than \$9 billion during the next 20 years.

Since 1988, the State Revolving Fund has provided \$2.4 billion to approximately 300 Missouri communities to construct and improve wastewater infrastructure. An additional \$290 million, primarily in the form of grants, has been invested by the state to further these purposes. Communities across the state have saved more than \$1.1 billion in interest and principal costs as a result of these programs. Continued availability and growth of these financial assistance programs will play a vital role in protecting Missouri's waters.



Our Missouri Waters

One of Missouri's most vital and necessary resources is its waterways. Our Missouri waters are not only essential for our health and quality of life; they also play a critical role in the state's overall economic well-being. Our lakes, rivers and streams provide us with quality drinking water, abundant fish stocks, irrigation, recreation and other vital services and uses.

In late 2011, the department launched its Our Missouri Waters effort to look at watershed management in a new way, viewing our water supply and water quality together. The effort is creating a coordinated approach to better protect and preserve Missouri's water resources.

Historically, the department has directed its efforts toward implementation of the federal Clean Water Act. In doing so, we focused on point source



The Mississippi River, viewed from a scenic overlook on the river bluffs above Trail of Tears State Park, near Cape Girardeau.

discharges or discharges from a pipe.

By addressing these types of discharges, we have made great strides in reducing pollution. However, pollutants remain and finding their source has become more challenging. We need more collaborative approaches to further identify the sources of pollution.

The department began or continued conversations with its many partners within the local communities of the Spring, Lower Grand and Big river watersheds during the pilot phase of the Our Missouri Waters effort. Great strides have been made in bringing into focus the shared vision for water resources within these watersheds. Our Missouri Waters' three pilot watersheds will remain in focus during the coming year.

In addition, in 2014, the department will include the Salt River Basin, Meramec Basin and the Missouri River Corridor, as well as the Sac, Niangua and Upper Mississippi – Cape Girardeau watersheds in its efforts. As the department brings

several more watersheds into focus each year, the overall goal will be to work through all of the 66 (HUC-8) watersheds over the next five years.

Continued public participation and building strong local partnerships will be the key to our success. We can't do this alone. We all need to understand and protect our waters to ensure a positive future, and the department needs the help of citizens, landowners, communities, industries and local leaders for this effort to be successful.

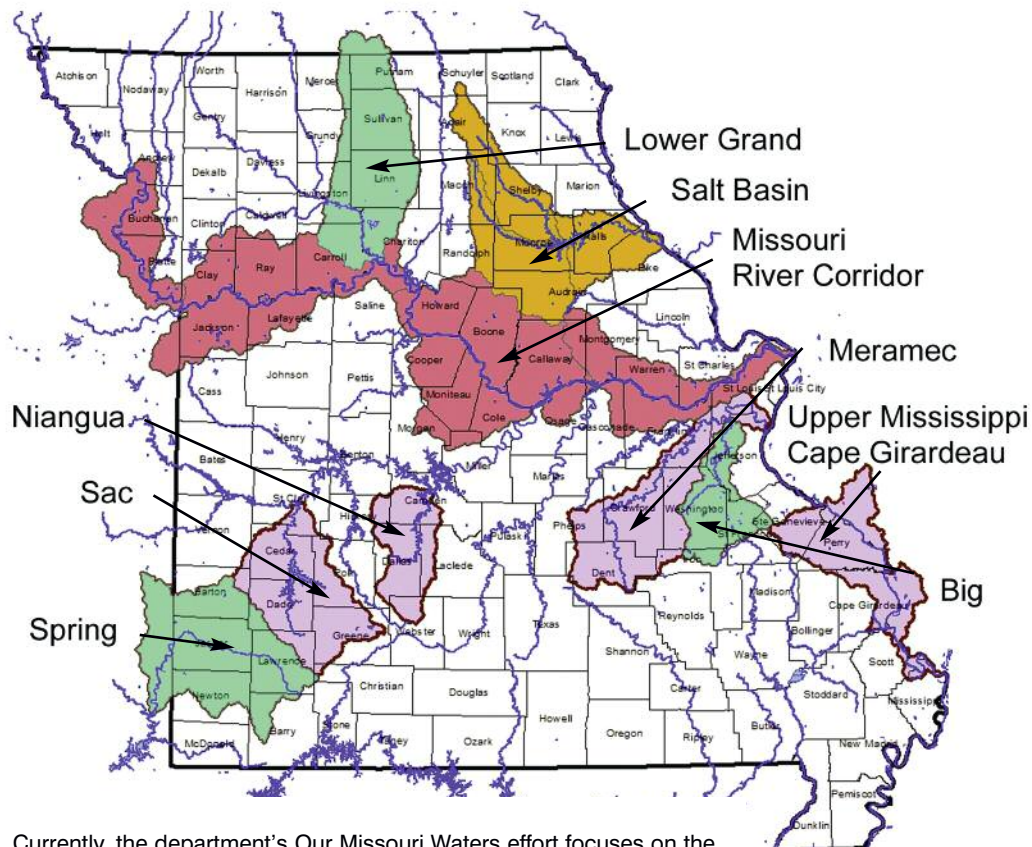
We hope to empower and support the local communities as they help create plans for ensuring clean and abundant water for generations to come. The Missouri Department of Natural Resources will target resources to increase the success of local plans and maintain a supportive role in this critical endeavor.

To learn more about Our Missouri Waters, visit the department's website at dnr.mo.gov/omwi.htm.

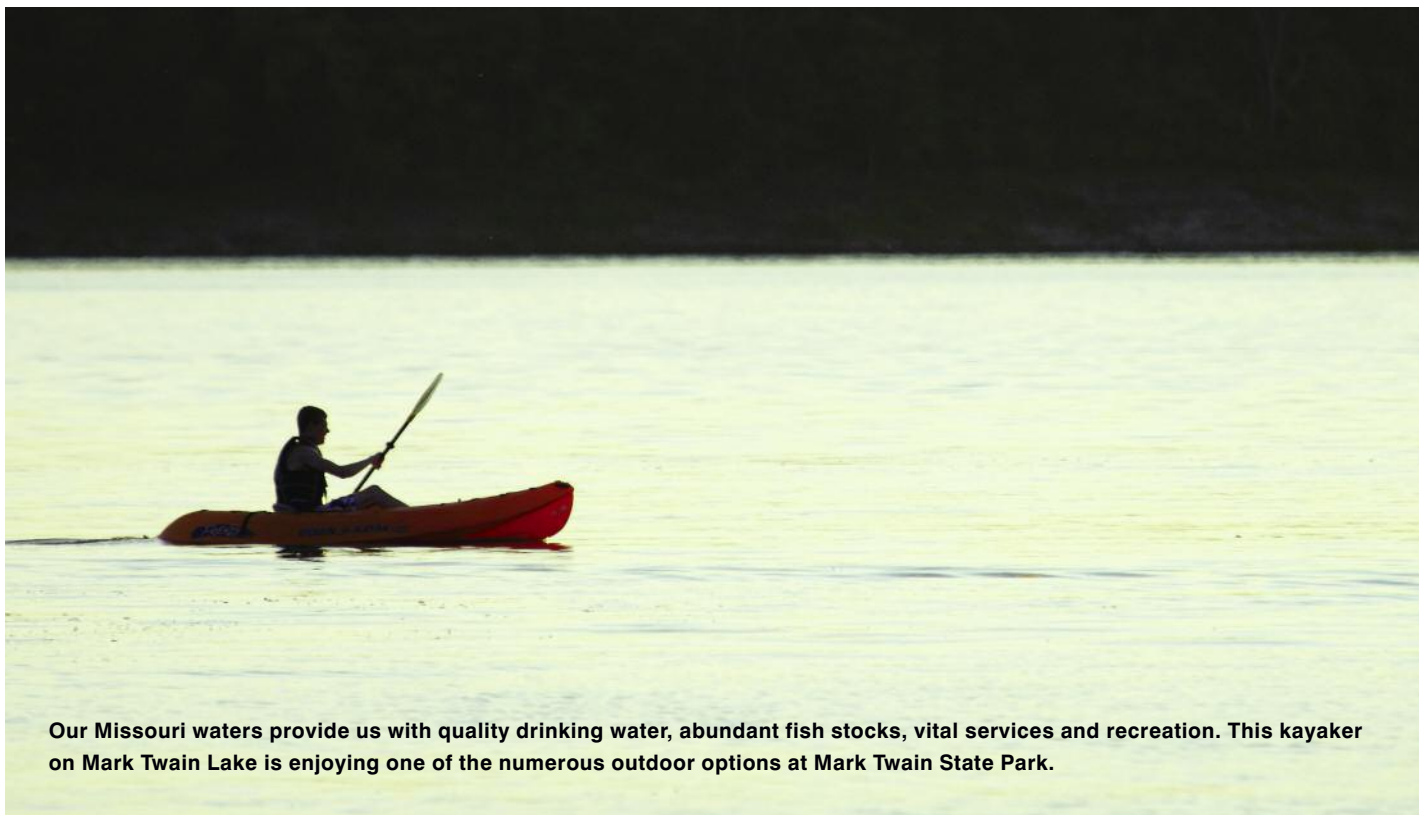
The Watersheds of Our Missouri Waters

Contact Your Watershed Coordinator

- Northeast Region Watershed Coordinator
660-385-8000
- Kansas City Region Watershed Coordinator
816-251-0719
- St. Louis Region Watershed Coordinator
314-416-2960
- Southeast Region Watershed Coordinator
573-840-9750
- Southwest Region Watershed Coordinator
471-891-4300



Currently, the department's Our Missouri Waters effort focuses on the watersheds included on this map. As the effort continues, it will expand to include all 66 watersheds in Missouri.



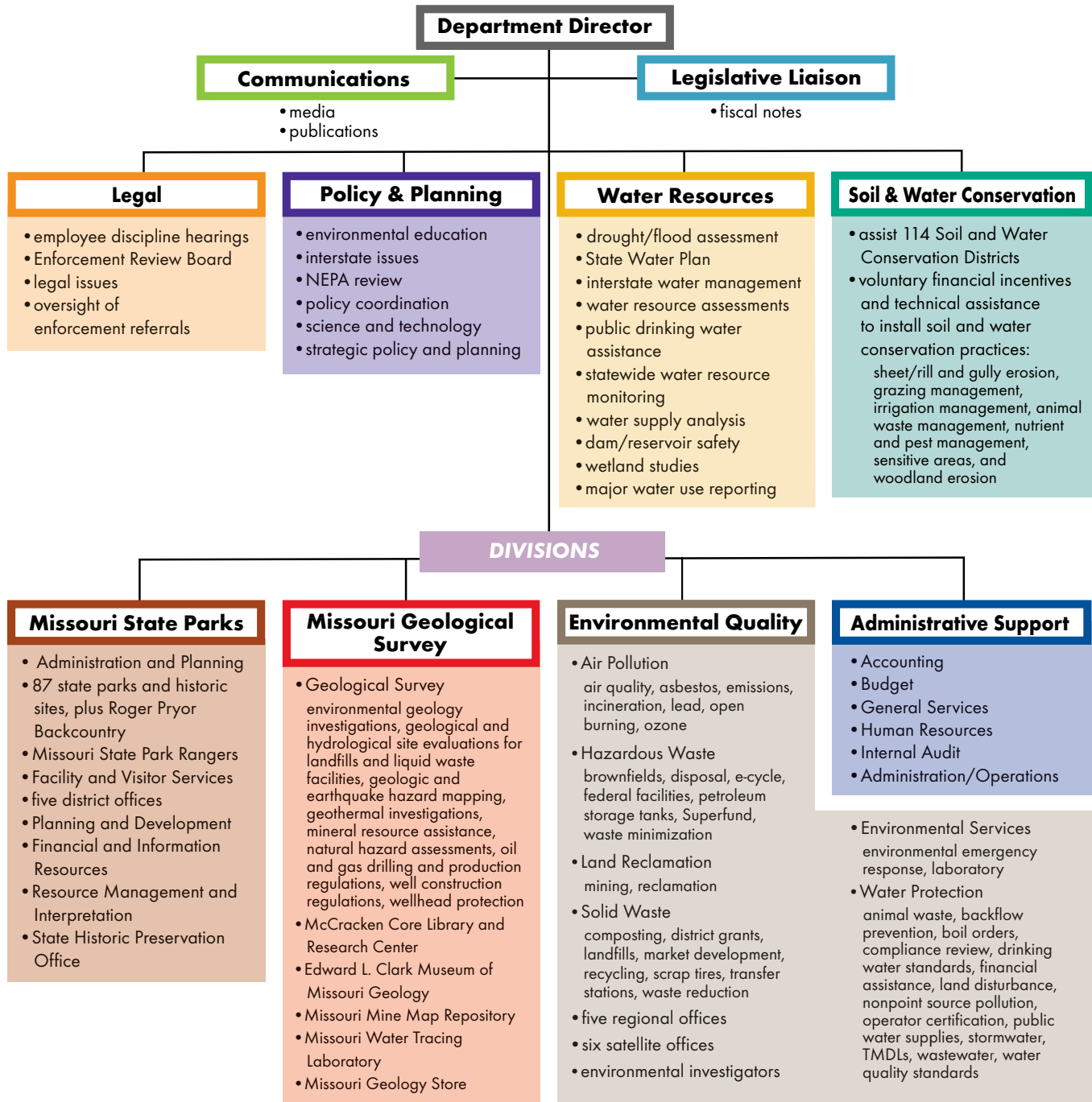
Our Missouri waters provide us with quality drinking water, abundant fish stocks, vital services and recreation. This kayaker on Mark Twain Lake is enjoying one of the numerous outdoor options at Mark Twain State Park.



An aerial view of Interstate 70, crossing the Missouri River near Rocheport, during the flood of 2007.

CHALLENGES: Protecting Our Water Resources

- Missouri's aging drinking water and wastewater infrastructure serving Missouri's cities and towns are in serious need of improvement or replacement. The cost to meet this need is estimated to be \$12.9 billion over the next 20 years. This need will continue to increase as new standards are implemented to protect drinking water and our rivers, lakes and streams.
- Monitoring data indicates which waters are healthy and which are not and what changes are needed to restore impaired waters. Monitoring data also enables the department to draft permits based on actual stream conditions, not conservative assumptions. Therefore, permits are less costly to comply with yet are protective of water quality. The department must increase its monitoring efforts to be successful in managing water quality.
- Mercury pollution from power plants both here and abroad, medical and hazardous waste incineration, cement kilns and dental waste, continue to pose particularly significant threats, making its way into Missouri's rivers and streams. Mercury is a local, regional and global problem.
- Nonpoint pollution affects almost half of Missouri's streams and rivers and approximately one-third of the lakes. Unlike point source pollution where the source of the pollution can be more readily determined, nonpoint pollution usually has multiple sources. Nonpoint source pollution creates a long-term challenge as it takes many years to determine the contributing sources and identify solutions.
- Resolving the combined sewer overflow and sanitary sewer overflow issues will require a substantial financial investment by communities and will take many years to implement. The department and EPA will need to work closely with each community to address this challenge.



BOARDS AND COMMISSIONS

Air Conservation Commission
 Clean Water Commission
 Dam and Reservoir Safety Council
 Environmental Improvement and Energy Resources Authority
 Geologic Mapping Advisory Committee
 Hazardous Waste Management Commission
 Industrial Minerals Advisory Committee
 Interstate Mining Compact Commission
 Land Reclamation Commission
 Missouri Advisory Council on Historic Preservation
 Missouri State Park Advisory Board

Missouri Trails Advisory Board
 Petroleum Storage Tank Insurance Fund
 Safe Drinking Water Commission
 Small Business Compliance Advisory Committee
 Soil and Water Districts Commission
 Solid Waste Advisory Board
 State Oil and Gas Council
 Unmarked Human Burial Consultation Committee
 Water Quality Coordinating Committee
 Well Installation Board

MISSOURI DEPARTMENT OF NATURAL RESOURCES

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